Provision of Extended Office Hours at the Usual Source of Care and its Effect on Healthcare Utilization and Expenditures in the Population of Adults with Chronic Ambulatory Care Sensitive Conditions

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Abstract

Healthcare providers and policy makers are increasingly experimenting with innovations that decrease healthcare costs while maintaining or improving patient health. Enhancing timely access to primary care and maintaining continuity of care through the provision of extended office hours at the usual source of care holds promise for successful chronic disease management that improves chronic disease outcomes and reduces healthcare costs by limiting the need for acute healthcare services. Evidence suggests that the health gains and cost reductions might be greatest for patients with conditions that are primary care treatable or primary care preventable (ambulatory care sensitive conditions). Using nationally representative data from the Medical Expenditure Panel Survey, this dissertation examines trends in the provision of extended office hours at the usual source of care (USC) for US adults with and without chronic ambulatory care sensitive conditions and assesses the effects of these additional service hours on healthcare utilization and expenditures among US adults with a chronic ambulatory care sensitive condition (ACSC).

The results of this dissertation indicate that the provision of extended office hours at the USC is associated with a reduction in total annual healthcare expenditures, emergency room utilization, inpatient utilization, and primary care utilization. However, despite these promising effects, only 1 in 4 US adults have a usual source of care that offers extended office hours and the provision of extended hours declined from 2005 to 2014.

These findings are important for national efforts on improving chronic disease outcomes and reducing national healthcare expenditures. However, considering the additional staffing and overhead cost required to implement extended office hours, future studies should focus on

determining the cost-effectiveness of the provision of extended office hours by the usual source of care.

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Chapter 1

Introduction

Purpose

Chronic diseases, such as heart disease and chronic lower respiratory diseases, are leading causes of morbidity and mortality, and have a huge economic burden in the United States and globally (Centers for Disease Control and Prevention, 2015; World Health Organization, 2014 & 2016). Ensuring timely access to primary care, while maintaining continuity of care, by providing extended office hours at the usual source of care, holds promise for successful chronic disease management and improved outcomes, including reducing the utilization of acute care services (Lowe et al., 2005; O'Malley, 2013; Zickafoose et al., 2013). Further, for conditions designated as ambulatory care sensitive, the role of timely access to ambulatory primary care becomes even more critical (Agency for Healthcare Research and Quality, 2001). The main objectives of this dissertation are to examine the trends in the provision of extended office hours at the usual source of care (USC) for US adults with and without a chronic ambulatory sensitive care condition and to investigate the effects of the provision of extended office hours at the USC on healthcare utilization and expenditures among US adults with a chronic ambulatory care sensitive condition.

Background

Morbidity and mortality burden of chronic diseases. Seven out of the ten leading causes of death in the United States are chronic diseases. Further, two of these chronic conditions- cancer and heart disease- account for nearly half of all deaths (Centers for Disease Control and Prevention, 2015). Globally, the mortality associated with chronic diseases is also

huge and rapidly increasing. Chronic diseases are responsible for 38 million of a total of 56 million deaths annually worldwide (about 70 percent) and are expected to cause up to 52 million deaths by 2030 (World Health Organization, 2014 & 2016).

In 2012, about half of all US adults – 117 million adults had at least one chronic disease, and one-quarter of all US adults had two or more chronic diseases (Ward, Schiller, & Goodman, 2014). Among older adults aged 65 or more, the prevalence of chronic conditions is even higher- approximately 92 percent have at least one chronic disease and three in four have more than one (Anderson, 2010; National Council on Aging, 2015).

The presence of chronic diseases also results in significant disability – about 40 million Americans have limitations in activities of daily living due to chronic diseases (National Center for Health Statistics (NCHS), 2013). Chronic conditions such as diabetes are associated with debilitating complications including kidney failure, non-traumatic amputation of the lower extremity, and blindness (Leasher et al., 2016; Melsom et al., 2016).

Further, many individuals living with chronic conditions have inadequately controlled disease. About half of US adults with hypertension have uncontrolled blood pressures (Egan, Zhao, & Axon, 2010), forty-three percent of those diagnosed with diabetes have poor glycemic control (Cheung et al, 2009), and four out of five with hyperlipidemia have not achieved cholesterol control (Ford, Li, Pearson, Zhao, & Mokdad, 2010).

The economic impact of chronic diseases. In addition to the heavy burden of morbidity and mortality, chronic diseases also have a substantial economic impact. Four out of the top five diseases contributing the most to national expenditures are chronic diseases – heart disease, cancer, mental disorders, and pulmonary diseases (Stanton & Rutherford, 2006). In 2010, eighty-six percent of the $2.7 trillion national healthcare expenditures in the US were for individuals

with chronic conditions (Centers for Disease Control and Prevention, 2015; Gerteis et al., 2014). Between 2008 and 2010, the economic impact of the five most common chronic conditions- cancer, diabetes, heart disease, hypertension, and stroke- accounted for about 10% of the national gross domestic product (Chatterjee, Kubendran, King, & DeVol, 2014). This translated to about $276.2 billion in direct treatment expenditures and $1,226 billion in an indirect loss to the national gross domestic product (Chatterjee et al., 2014).

Increased utilization of high-cost health services such as emergency room (ER) care and hospital admissions among individuals with chronic conditions account for a considerable proportion of the direct expenditures on chronic conditions. About one-third of the healthcare cost of individuals with chronic conditions are from inpatient admissions (Gonzalez, 2013), and for some conditions such as diabetes up to half of the expenditures are from inpatient admissions (American Diabetes Association, 2008).

Moreover, a considerable proportion of these high-cost ER and inpatient visits are avoidable or could have been effectively treated in the primary care setting (Johnson et al., 2012; Moy, Chang, & Barrett, 2013; Pitts, Carrier, Rich, & Kellerman,2010; Weinick, Burns, & Mehrotra, 2010). Some common chronic conditions, including congestive heart failure, diabetes, asthma, chronic obstructive pulmonary disease, and hypertension have been designated by the Agency for Healthcare Research and Quality (AHRQ) as ambulatory care sensitive. The Agency for Healthcare Research and Quality (2001) defines Ambulatory Care Sensitive Conditions (ACSCs) as those conditions "for which good outpatient care can potentially prevent the need for hospitalization, or for which early intervention can prevent complications or more severe disease."

For conditions that are primary care treatable or primary care preventable, providing care in the primary care setting rather than in the emergency room promises to yield significant savings to the healthcare system. In a nationally representative study, which utilized data from the Medical Expenditure Panel Survey (MEPS), the authors reported that more than half of the care delivered for primary care treatable or primary care preventable conditions were in high-cost acute care settings, rather than in the primary care setting (Galarraga, Mutter, & Pines, 2015). Further, the bulk of differences in payments for care received across settings were attributable to facility fee differences rather than intensity of care received (Galarraga et al., 2015). These findings suggest that reducing the utilization of high-cost acute care services for conditions that could be effectively treated in the primary care setting presents opportunities to limit waste and contain national healthcare cost.

The role of primary care. Due to the chronicity, fluctuating course, and complex nature of chronic diseases, continuous and timely access to a primary care provider is critical to achieving adequate control and preventing poor outcomes (Chaiyachati et al., 2014; Rothman & Wagner, 2003; Starfield, Shi, & Macinko, 2005). Individuals with chronic diseases in countries with stronger primary care delivery systems have been shown to have better outcomes, including better self-rated health status (Hansen, Groenewegen, Boerma, & Kringos, 2015), lower mortality (Starfield & Shi, 2002), and less utilization of expensive higher-acuity care (Kringos, Boerma, van der Zee, & Groenewegen, 2013; Schoen, Osborn, How, Doty, & Peugh, 2009b). Further, studies have demonstrated associations between better access to primary care, including having a regular physician, ease of obtaining appointments and contacting the provider by phone, and decreased acute care utilization among individuals with chronic conditions (Ansell et al., 2002; Davidson, Giancola, Gast, Ho, & Waddel, 2003; Cowling et al., 2013; McCusker et al.,

2010).

Specific characteristics and functions such as care coordination, continuity, and comprehensiveness make primary care well suited to successful chronic disease management (Rothman & Wagner, 2003). The care coordination function of primary care which integrates care from different providers into the ongoing care of patients is important in chronic disease management because individuals with chronic diseases often require multi-disciplinary care either due to multiple complications arising from their single chronic disease or due to the presence of multiple chronic diseases. In addition, there is increasing evidence that a continuous relationship with a provider or team of providers improves outcomes and lowers cost in chronic disease management (Chaiyachati et al., 2014; Nelson et al., 2014).

Regrettably, on many dimensions, access to primary care for many Americans, including those with chronic conditions, is impaired. A report by the National Association of Community Health Centers (2014) showed that up to 62 million Americans have inadequate or no primary care access. Further, individuals with chronic conditions, a considerable proportion of whom are elderly and on Medicaid or Medicare, have more barriers to accessing primary care (Shi, 2000). This disparity may be partly due to lower reimbursement by Medicare and Medicaid (Chou, Cooney, Van Ness, Allore, & Gill, 2007; Dayaratna, 2012). A survey of Medicare beneficiaries showed that 28 percent of those who had no primary care physicians reported difficulty finding one (MedPAC, 2009).

However, having a primary care physician does not necessarily translate to easy access to care when needed. In a 2006 Commonwealth survey of a nationally representative sample of nonelderly US adults, only one in four individuals who have a primary care provider have easy access to their provider over the telephone, experience timely visits, or can obtain care or

medical advice after hours (Beal, Doty, Hernandez, Shea, & Davis, 2007). Lack of timely access to primary care services has been cited as one of the main drivers of ED overuse (Rust et al., 2008) and poor outcomes like increased mortality (Prentice & Pizer, 2007). The study by Rust et al (2008) reported that the prevalence of ED visits was increased among all adults, including those with chronic conditions, who reported barriers to timely access to primary care such as lack of provider hours when they needed care, inability to get through to the provider on phone and delay in getting an appointment. When chronic disease patients are unable to access primary care when needed, they may experience worsening of their illness resulting in the need for emergency room utilization, inpatient admissions, or increased risk of mortality (Jerant, Fenton, & Franks, 2012a; Starfield, Shi, & Macinko, 2005).

Recent healthcare policies encourage implementation of innovations like the Patient-Centered Medical Home model to redesign primary care delivery (Davis, Abrams, & Stremikis, 2011). Among other components, this model attempts to enhance access to primary care through the provision of after-hours care, same day scheduling, and constant access to the healthcare team through phones and secure email messaging (American Academy of Family Physicians, 2008).

After-hours care. After-hours care refers to the provision of primary care outside of the regular business hours, that is, primary care provided on weekends, holidays, and between 5 pm to 8 am on Mondays to Friday (O'Malley, Samuel, Bond, & Carrier, 2012). The article by O'Malley and coauthors (2012) identified different approaches utilized by primary care teams to provide after-hours care, including expansion of office hours at the usual source of care to evenings and weekends for face to face visits (extended office hours), phone consultation with an on-call nurse or physician, and contracting with urgent care clinics for the provision of after-

hours care and communication back to the primary care team.

Besides the provision of after-hours care through approaches designed by a patient's usual primary care team, after-hours access to primary care can also be provided by urgent care centers not connected to the usual primary care team. Although utilization of urgent care centers may reduce emergency room visits (Merritt, Naamon, & Morris, 2000; Weinick et al., 2010), it poses a threat to the continuity of primary care and leads to fragmentation of care from different systems that are not coordinated to communicate with each other (Ladapo & Chokshi, 2014; Murray & Berwick, 2003; Yee, Lechner, & Boukus, 2013). A continuous relationship with a usual primary care provider or team of providers who is familiar with the patient has been associated with improved outcomes, especially for more complex patients, such as those with chronic conditions (Chaiyachati et al., 2014; Nelson et al., 2014).

Maintaining continuity with a usual provider also encourages an incremental strategy to problem-solving in clinical diagnosis and management. This approach focuses on following up a clinical symptom over time and builds on the foundation of a basic understanding and familiarity with the patient's baseline health status and social environment. A recent article by Atul Gawande (2017) in the *New Yorker* discusses the effectiveness and the superiority of the incremental approach to clinical evaluation. This approach contrasts with the episodic nature of care received from urgent care centers.

In addition to the provision of extended office hours by the usual primary care team, the "enhanced access to primary care" component of the PCMH initiative also advocates the provision of same-day scheduling, and 24-hours a day, 7-days a week access to the primary care team through email messaging, telephone access, and patient portals. These alternative methods of enhancing primary care access may decrease the need for extended office hours (Murray &

Berwick, 2003; O'Malley et al., 2012). Nevertheless, the importance of extended office hours in providing face to face visits for health care needs arising outside of regular hours cannot be over-emphasized. While the history of a patient's clinical problem can be obtained virtually, face to face visits allow for a thorough physical examination which is often vital to accurate clinical assessments and treatment plan development for ongoing conditions or recent exacerbations of chronic conditions (Campell & Lynn, 1990).

Using nationally representative data from the Medical Expenditure Panel Survey, this dissertation examines the effect of the provision of extended office hours at the usual source of care on healthcare utilization and expenditures among adults with a chronic ambulatory care sensitive conditions. Specifically, this dissertation provides a nationally representative estimate of American adults who have a usual source of care offering evening and weekend hours, examines trends in the provision of extended office hours over 10 years, and examines the association between the provision of extended office hours at the usual source of care and healthcare utilization and expenditures in the population of adults with chronic ambulatory care sensitive conditions (ACSCs). The chronic conditions included in the ACSC's definition, which was also used to define chronic ACSCs in the present study, are heart diseases (Angina and heart failure), asthma, chronic obstructive pulmonary diseases, diabetes, and hypertension.

The main variable of interest in this dissertation (provision of extended office hours) only captures one dimension of access to extended office hours. This variable is not able to capture actual access or ability to utilize the provided access. For example, an individual may have a primary care provider who offers extended office hours but may be unable to utilize primary care when needed due to other limitations such as lack of access to transportation or inability to afford required payment at the time of service. On the other hand, it may be easier to utilize the

emergency room considering the availability of ambulance services. Evidence from the literature suggests that Medicaid patients and other patients with low socioeconomic status are more likely to perceive care in the emergency room as more accessible, more affordable, and more convenient than a visit to the primary care provider (Capp, Camp-Binford, Sobolewski, Bulmer, & Kelley, 2015; Kangovi et al., 2013).

The gap between the provision of extended office hours and actual access to care may result in a difference in the effect of the provision of extended office hours for separate groups of patients. For patients whose only barrier to primary care access is a lack of extended office hours, provision of extended office hours will likely improve their outcomes and reduce acute care utilization. On the other hand, providing extended office hours may result in no effect for those who experience other barriers to care. As earlier discussed, patients on Medicaid who also have low socioeconomic status typically experience more barriers to primary care access (Shi, 2000). To address this difference in the effect of the provision of extended office hours, this dissertation also examined whether the association between extended office hours and healthcare utilization and expenditures differed by health insurance status.

In addition, considering that extended office hours, same-day scheduling, and constant email or phone access to the primary care team are all components of the PCMH initiative, it is likely that individuals who have access to one, may also have access to the others. Nevertheless, the literature suggests that there is considerable variation in the operationalization of the PCMH model by different primary care practices (Hoff, Weller, & DePuccio, 2012). This variation means that some providers may offer extended office hours but not offer same-day scheduling or constant email and phone access. However, considering that it is more expensive and challenging to implement extended office hours than other access enhancing strategies (O'Malley et al.,

2012), it is more likely that practices who offer extended office hours will also offer same-day scheduling and constant email and phone access. Regrettably, the MEPS data do not provide information on same-day scheduling, and constant email or phone access to the primary care team. This lack of data poses a challenge to delineating the effect of extended office hours from the other strategies to increase communication and access to care. To mitigate some of the bias resulting from this omitted information, this dissertation also utilizes a strategy that estimates two equations, one for the provision of extended office hours and the other for the outcome variables, while allowing for correlation between the error terms of the two equations.

This dissertation focuses on the effect of the provision of extended office hours rather than same-day scheduling or constant email/phone access. The provision of same-day scheduling enhances timely access to primary care when care is needed during regular business hours. However, the literature suggests that a considerable proportion of non-emergent ER utilization is for conditions arising after hours rather than during regular business hours (Niska, Bhuiya, & Xu, 2010; Pitts et al., 2010). Further, in contrast to constant email and phone access to the primary care team, the provision of extended office hours by the primary care team affords the opportunity for face to face clinical encounters. This allows for thorough physical examination which is essential to accurate clinical evaluation and treatment plan development (Campbell & Lynn, 1990). Finally, the provision of extended office hours at the USC is likely to offer more time flexibility for individuals who are unable to or unwilling to take time off work to receive regular preventive and chronic disease care (Medical Office Today, 2012).

Considering the potential effect of the provision of extended hours at the usual source of care on improving primary care delivery and hence chronic disease outcomes, this dissertation examines the effect of extended hours on healthcare utilization and outcomes in the population of

adults with chronic ambulatory care sensitive conditions. The specific research questions of this dissertation are presented below.

Research Questions

1. What is the proportion of US adults, with or without a diagnosis of a chronic ACSC, who have a usual source of care (USC) offering hours in the evenings or weekends? How does this proportion differ by population characteristics and how has this changed over the past 10 years?
2. a) What is the association between the provision of extended office hours at the usual source of care and the measures of healthcare utilization and expenditures in the population of all US adults with a diagnosis of a chronic ACSC, and in subpopulations of types of chronic ACSCs?

   b.) How does this association differ by insurance status?
3. Are the observed associations between extended office hours and the measures of healthcare utilization and expenditures robust to allowing extended office hours at the USC and healthcare utilization and expenditures to be jointly determined?

Overview of Subsequent Chapters

Chapter 2 discusses previous scholarly work which is relevant to the topic of this dissertation. Specifically, it reviews the literature on the role of improved primary care delivery on chronic disease outcomes, barriers to primary care access, and the effect of enhancing timely access to primary care through the provision of office hours in the evenings and weekends.

Chapter 3 describes the methodology of this dissertation. It outlines the description of the data source, study population and sample, the specification of variables. It concludes with a

discussion of the statistical analytical models utilized to examine the research questions of this dissertation.

Chapter 4 presents the results of this dissertation, organized according to the research questions. Finally, chapter 5 discusses the findings of the study, implications for practice and policy, the limitations of the study and future research opportunities.

Chapter 2

Literature Review

Improving Primary Care Delivery for the Chronic Disease Population

With increasing recognition of the importance of primary care on outcomes for patients with chronic conditions, health care providers are increasingly looking to primary care innovations to improve health outcomes for chronically ill patients. Individual interventions, multi-component models and frameworks including the chronic care model, patient-centered medical home model, chronic diseases self-management education programs, and group medical visits are being implemented. Evaluations of these interventions and models show some success, however, the results are far from conclusive (Bodenheimer, Wagner, & Grumbach, 2002; Coleman, Austin, Brach, & Wagner, 2009; Hoff, Weller, & DePuccio, 2012; Jackson et al., 2013). Little is known about how specific interventions like the provision of extended office hours, which aims to ensure timely access to primary care, independently affect patients' outcomes.

Barriers to Timely Primary Care Access

A growing number of studies have described factors associated with impaired primary care access in the chronic disease population. These can be broadly classified into provider-side factors and patient side-factors. Patient-side factors include: negative subjective experiences with the healthcare system resulting in distrust of the system (Capp et al., 2016), avoidance of care due to stigma from being overweight or obese (Weaver et al., 2014), and challenges associated with low socioeconomic status such as lack of transportation (Capp et al., 2016; Cheung, Wiler, Lowe, & Ginde., 2012). While some of these studies are representative of the US population (Cheung et al., 2012), others might not be generalizable to individuals with chronic conditions in

the US as they were restricted to select groups such as the Medicaid population (Capp et al., 2016), or were based on data from another country (Weaver et al., 2014).

Provider-side factors described in the literature include: lower acceptance of publicly insured (both Medicaid and Medicare) patients compared to privately insured patients among primary care physicians accepting new patients (Chou et al., 2007; Grewal et al., 2013); lack of hours in the evenings and weekends when patients needed care or were available to seek care (Rust et al., 2008); lack of available appointments or long wait times before available appointments for episodic care needs (D'Avolio, Strumpf, Feldman, Mitchell, & Rebholz, 2013; Prentice & Pizer 2007) ; and difficulty contacting primary care teams by phone (Rust et al., 2008).

Effect of Lack of Timely Access to Primary Care

Lack of timely access to primary care has been linked to increased rates of ED visits, increased hospitalizations for ambulatory care sensitive conditions, and increased healthcare expenditures (Ansell et al 2002; Hummel, Mohler, Clemens, & Duncan, 2014; Kronman, Ash, Freund, Hanchate, & Emanuel, 2008; McCusker et al., 2010; Rust et al., 2008). None of these studies is generalizable to individuals with chronic conditions in the US. One of the studies is generalizable to the adult US population (Rust et al., 2008), while others are limited to selected sub-groups such as elderly Medicare beneficiaries at end of life (Kronman et al., 2008) or a selected hospital and state (Ansell et al., 2002), or present evidence from another country (McCusker et al., 2010). One of these studies operationalizes access to primary care as having a regular source of care (McCusker et al., 2010); this represents potential access to primary care and may not accurately reflect actual access to care when needed. Other studies improved on this limitation by looking at actual primary care access in terms of barriers to accessing care when

needed (Janke et al., 2015; Rust et al., 2008) or in the actual number of primary care visits (Kronman et al., 2008). The study by Ansell and colleagues (2002) operationalized access as both having a regular PCP and actual primary care visit in separate analyses; the effect observed for actual primary care visits was greater than that of having a regular primary care physician.

In contrast to evidence linking lack of primary care access to higher ED and hospital utilization, other studies have suggested that more access to primary care is associated with more ED visits, with individuals having 3 or more primary care visits more likely to be frequent ED utilizers (Byrne et al., 2003; Cunningham, Mautner, Ku, Scott, & LaNoue, 2016; Zuckerman & Shen, 2004). While improving access to primary care may not be associated with reduced ED visits among frequent utilizers who are likely to be individuals with poorly controlled chronic conditions, enhancing access to primary care is likely to reduce ED visits among occasional ED utilizers. Even for the frequent ED utilizers, providing same-day primary care access and access during off-hours (evenings and weekends) may help divert these frequent ED visits.

For this dissertation, the focus is on provider-side factors, specifically the lack of primary care office hours in the evenings and weekends. This has been cited as one major barrier to accessing primary care, leading patients to inappropriately seek care in the emergency department (Janke et al., 2015; Rust et al., 2008; Uscher-Pines, Pines, Kellermann, Gillen, & Mehrotra, 2013). Despite having a usual primary care provider, patients may have to utilize the ER if they need care at a time when their primary care offices are closed. Further, due to job constraints, some patients may only be able to seek primary care in the evenings and on weekends; lack of primary care office hours during these periods can preclude receipt of regular chronic care leading to poor outcomes, including the development of avoidable emergent conditions needing ER and inpatient care.

Extended primary care office hours and outcomes

From the health system perspective, provider-side barriers to timely primary care access may be more amenable to policy and clinical interventions than the patient-side factors. Major provider-side factors preventing actual access to primary care when needed include lack of hours in the evenings and weekends, lack of same-day appointments, and difficulty contacting providers by phone. New models of primary care delivery such as the Patient-Centered Medical Home incorporate "enhanced access" as one of their principles. Strategies such as open-access scheduling which ensures patients are able to obtain appointments the same day they need care, expansion of primary care office hours to evenings and weekends, and provision of new communication options through phone and secure e-mail messaging, are used to enhance access to primary care in the PCMH model of primary care delivery. For this dissertation, the focus is on the expansion of primary care office hours to evenings and/or weekends.

Available evidence on the provision of extended primary care office hours generally suggests an association with significant reduction in emergency room visits (Howard et al., 2008; Jerant, Bertakis, Fenton, & Franks, 2012b; Lowe et al., 2005; O'Malley, 2012; Wang, Villar, Mulligan, & Hansen, 2005; Zickafoose, DeCamp, & Prosser, 2013). On the other hand, the available evidence on the effect of extended office hours on healthcare expenditure is conflicting. Some studies report an association of extended office hours with lower ED expenditures (Stockbridge, Philpot, & Pagan, 2014; Wang et al., 2005), lower outpatient expenditures (Stockbridge et al., 2014), and lower total healthcare expenditures (Jerant et al., 2012b) while some found no significant difference in total expenditures (Wang et al., 2005). No study was found on the association between the provision of extended office hours and inpatient utilization.

All but one of the studies were conducted in the US (Howard et al., 2008). One of the studies focused on adults 18 years or more (Jerant et al. 2012b), two of the studies focused on the pediatric population (Wang et al., 2005; Zickafoose et al., 2013), while the remaining three combined the pediatric and adult population (Howard et al., 2008; O'Malley et al., 2012; Lowe et al., 2005). Two of the studies utilized large nationally representative data and are thus generalizable to the US population (O'Malley et al., 2012; Jerant et al., 2012), others were limited to selected states (Lowe et al., 2005; Wang et al., 2005) or selected subgroups such as the Medicaid population (Lowe et al., 2005; Wang et al., 2005). None of these studies focused on the chronic disease population, and one study excluded patients with chronic conditions (Wang et al., 2005).

Measurement was not a limitation in most of the studies reviewed as they appropriately operationalized the provision of extended office hours, healthcare utilization, and healthcare expenditure. Some of the studies separated provision of extended office hours on nights from weekends (Lowe et al., 2005; Wang et al., 2005; Zickafoose et al., 2013), while some did not differentiate evening hours from weekend hours (Howard et al., 2008; Jerant et al., 2012). The study by O'Malley (2012) operationalized the independent variable as "How difficult is it to contact a provider at your usual source of care?" In addition to the provision of extended office hours, this variable will capture other forms of after-hours access including phone and email.

The observed association between the provision of extended office hours and reduced ED visits may not be entirely attributable to extended office hours. In some of the studies, other initiatives were concurrently implemented with the provision of extended office hours and may be responsible for the observed reduction in ED visits (Howard et al., 2008; Wang et al., 2005). In the study by Howard and colleagues (2008), which was conducted in Canada, the provision of

extended office hours was bundled with other incentives and services such as 24/7 physician telephone access, and a financial penalty for practices whose panelled patients visited another physician. Similarly, the study by Wang et al. (2005) evaluated a pilot ED diversion project which combined the provision of extended primary care office hours with case management, walk-in services not requiring prior appointments, and after-hours telephone nurse triage.

Others had methodological limitations such as non-response bias from a low response rate (Zickafoose et al., 2013), and lack of adjustment for factors associated with increased ED visits such as health status (Wang et al., 2005). In addition, some of the studies may have some selection bias (Howard et al., 2008; Wang et al., 2005). In the study by Howard et al. (2008), patients self-selected into practices; the practices which provided extended office hours were practices who voluntarily participated in Canadian primary care reform. There may be some unobserved patient characteristics simultaneously related to a patient's choice of a practice providing extended office hours and their ED utilization. There may also be some factors related to a practice's choice of participation in primary care reform and the quality of care provided which may then determine the patient's need for emergent care. Similarly, in the study by Wang et al. (2005) patients self-selected into the intervention group. While the other studies (Jerant et al., 2012; Lowe et al., 2005; O'Malley et al., 2012; Zickafoose et al., 2013) were population-based studies and had no obvious selection into the intervention, there may still be unobservable factors simultaneously related to having a primary care provider who offers extended office hours and ED visits.

Simultaneity and reverse causation is also a limitation in most of the studies. All but one of the studies on extended office hours and ED visits utilized cross-sectional survey data making

it difficult to establish temporality between the predictor and outcome variables (Howard et al., 2008; Lowe et al., 2005; O'Malley et al., 2012; Wang et al., 2005; Zickafoose et al., 2013).

Studies to date on the effect of the provision of extended office hours on patient outcomes, specifically on healthcare utilization and expenditures do not provide strong and conclusive evidence on the effect of extended hours and have significant limitations such as selection bias, response bias from low response rate, lack of temporality, and contamination from other initiatives. Further, no previous study has examined the effect of the provision of extended hours on health care utilization and expenditures in the population of adults with chronic ambulatory care sensitive conditions. Utilizing nationally representative longitudinal data, this dissertation examines the trends in the provision of extended office hours at the usual source of care (USC) among all US adults and the effect of extended hours at the USC on health care utilization and expenditures among the population of US adults with chronic ambulatory care sensitive conditions (ACSCs).

The results of the dissertation contribute to available evidence on the provision of extended office hours by focusing on the population of adults with chronic ambulatory care sensitive conditions while improving upon the limitations of the previous studies. The use of longitudinal data capturing participants' information in the first and second year allows for the establishment of temporality, mitigating simultaneity and reverse causation concerns in the present study by using the availability of extended hours in the first year to predict outcomes in the second year. Further, in addition to controlling for observed variables (indicated in the conceptual models below) that may be jointly associated with selection into a practice offering extended hours and healthcare utilization, this study used an analytical technique that mitigated residual selection bias from unobserved variables. Although attempts at addressing selection in

this dissertation may not exhaustively remove the effect of selection bias on the relationship between extended hours and the outcome variables, it improves upon the analysis in previous studies. In addition, the present study used a large sample which was also weighted to produce nationally representative estimates, hence response bias from low response rates is not a limitation in the present study.

Conceptual Frameworks for Healthcare Utilization and Expenditures in Adults with chronic ACSCs

This section presents frameworks describing the relationship between the outcomes of interest (acute care utilization, primary care utilization, and healthcare expenditures) and their determinants. Given that healthcare expenditures are incurred when individuals utilize health care, the same factors are likely to affect both utilization and expenditures. However, it is likely that the determinants of primary care utilization will differ from the determinants of acute care utilization because primary care settings provide care for non-acute conditions. Factors leading to the development of conditions perceived to be nonacute are likely to be different from those leading to the development of conditions perceived to be acute.

Conceptual framework for emergency room utilization and expenditures. Figure 2.1 below presents the conceptual framework for emergency room utilization. Broadly speaking, emergency room utilization can be said to be a function of an individual's perception of the acuity or severity of the condition for which care is sought, the availability of alternate sources of care, and the cost of available options. The equation of these basic factors is of the form: ER utilization = F (**perception of acuity or severity of disease; available options**- could be urgent care centers, extended office hours at the usual source of care, or extended access at the usual source of care through email messaging or phone**; cost of available options**).

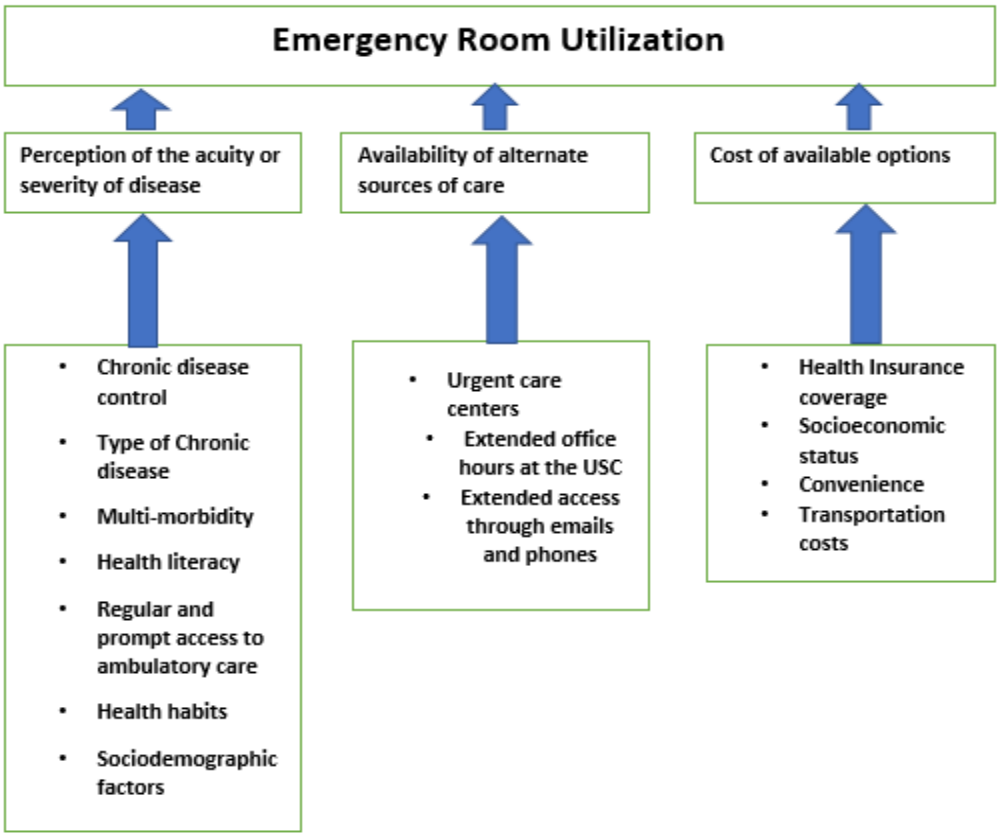

Figure 2.1: Conceptual Framework for ER Visits

Perception of the acuity or severity of disease. A patient's perception of the severity of their condition is likely to influence their decision to utilize the ER. Patients are more likely to utilize the ER for conditions perceived to be severe such as difficulty with breathing, blood loss, and severe pains. For adults with chronic ACSCs, the likelihood of developing an acute exacerbation of a chronic condition which will be perceived as severe and needing emergency room care may be predicted by 1) whether the chronic disease is adequately controlled, 2) the type of chronic disease, 3) the presence of multiple chronic conditions, 4) health literacy, 5) regular and prompt access to ambulatory care, 6) harmful health behaviors such as smoking, and 7) sociodemographic factors such as age and race.

Patients with poorly controlled disease are more likely to experience acute worsening compared to those whose diseases are adequately controlled, and hence may be more likely to utilize the ER compared to those with well managed disease. For example, for patients diagnosed with diabetes, poor blood glucose control has been linked with higher incidence of adverse events requiring ER utilization or hospitalization (Levine et al., 2001; Shurraw et al., 2011).

Further, the specific type of chronic ACSC is likely to affect the likelihood of developing certain acute conditions commonly treated in the emergency room. Acute conditions such as difficulty with breathing and chest pain are common presentations of heart failure, COPD, and asthma, thus patients with these three diseases may be more likely to utilize the ER compared to patients with diabetes or high blood pressure. Data from the Centers for Medicare and Medicaid Services (CMS) on healthcare utilization for different chronic conditions indicates this to be the case as the rate of ER visits in 2015 among Medicare beneficiaries with the chronic conditions included in the present study are in the following order: asthma (1937.7 per 1000), COPD (1772.3 per 1000), heart failure (1704.2 per 1000), diabetes (1010.7 per 1000), and hypertension (954.4 per 1000) (Centers for Medicare and Medicaid Services, 2017).

Another closely related factor that contributes to poor outcomes and increased need for acute care in individuals with chronic conditions is the presence of multiple chronic conditions (Lehnert et al., 2011; Wolff, Starfield, & Anderson, 2002). This is likely due to individuals with multiple chronic conditions being more prone to adverse events from the increased complexity of care and polypharmacy (Budnitz, Lovegrove, Shehab, & Richards, 2011).

Considering the crucial role of self-management in the outcomes of patients with chronic diseases (Bodenheimer, Lorig, Holman, & Grumbach, 2002; Chodosh et al., 2005; Franek, 2013), the ability of patients to understand, interpret and correctly utilize health information -

health literacy- is very important. There is increasing evidence supporting an association between low health literacy and poor outcomes, including ER utilization and poor health status (Bennett, Chen, Soroui, & White, 2009; Berkman, Sheridan, Donahue, Halpem, & Crotty, 2011; DeWalt, Dilling, Rosenthal, & Pignone, 2007; Griffey, Kennedy, McGownan, Goodman, & Kaphingst, 2014).

There is extensive evidence supporting the importance of access to primary care on patient outcomes (Cowling et al., 2013; Hansen et al., 2015; Kringos et al., 2013; Schoen et al., 2009b). Expanding access to primary care through strategies such as the provision of extended office hours at the usual source of care, same day scheduling, and constant telephone and email access is likely to improve outcomes, including reducing the need for higher acuity care. These health gains may be greatest for ambulatory care sensitive conditions which are conditions "for which good outpatient care can potentially prevent the need for hospitalization, or for which early intervention can prevent complications or more severe disease" (AHRQ, 2001).

Another key factor that is likely to affect the outcomes of patients with chronic ACSCs is age. Age-related physiologic changes and a greater degree of frailty with age are likely to contribute to increased burden and complexity of chronic conditions with increasing age (Anderson, 2010; National Council on Aging, 2015). In addition, multiple chronic conditions are more common among elderly adults aged 65 years or more (Lehnert et al., 2011; Vogeli et al., 2007; Ward & Schiller, 2013) further increasing their likelihood of needing ER utilization.

There is also some evidence suggesting that compared to Hispanics and non-Hispanic Whites, non-Hispanic Blacks have worse chronic disease outcomes including higher rates of cardiovascular mortality, poorer blood glucose control and higher rates of diabetes-related complications, and poorer blood pressure control (Bulger, Shubrook, & Snow, 2012; Fayfman et

al., 2016; Fiscella & Holt, 2008; Galea et al., 2007). Given evidence indicating poorer chronic disease control in non-Hispanic blacks, they may also have higher emergency room utilization compared to other races.

Finally, unhealthy behaviors such as smoking are likely to affect the outcomes of patients with chronic ACSCs.

Availability of alternate sources of care. When conditions that are not clearly emergent and life-threatening arise after hours, the availability of sources of care other than the ER becomes important in influencing patients' decisions to utilize the ER. Patients who have primary care providers providing evening and weekend hours may be less likely to utilize the ER for such non-acute conditions. Further, clinical conditions may develop during regular hours, but patients may not be able to seek care due to work. Having access to their usual source of care after hours is likely to encourage patients to promptly seek care for such conditions and prevent the development of complications (Lowe et al., 2005; O'Malley, 2013).

In addition to extended office hours at the usual source of care, urgent care centers present another source of after-hours care. While this is likely to potentially divert patients from the emergency room, it may not improve patient outcomes in the long term. Continuity of care and care coordination afforded by seeing patients at the usual source of care or in a facility integrated with the patient's usual source of care is crucial to improving patient outcomes (O'Malley et al., 2012). Further, the provision of extended office hours by a primary care team with which the patient is familiar rather than an unfamiliar urgent care center is likely to prevent delay in seeking care.

Additionally, extended access to the usual source of care through constant email and phone access to the primary care team also provide an alternative source of care after hours.

However, it may drive ER utilization rates. There is some evidence suggesting that when patients call their usual sources of care after hours, they are often advised to go to the ER (Kangovi et al., 2013). This may in part be due to the inability of the providers to accurately evaluate patients' need via a phone conversation or email messaging.

Cost of available options. The direct or indirect cost of available options will also affect the likelihood of ER utilization versus primary care utilization. Health insurance status and socioeconomic status would be the major determinants of these costs. For Medicaid patients and individuals with low socioeconomic status, primary care utilization may be associated with higher indirect costs. A qualitative study exploring reasons for emergency room utilization by patients with low socioeconomic status who were uninsured or on Medicaid suggests this to be the case as the study participants reportedly experience higher costs when they visit their PCP because of the additional time and expense associated with referral to specialists and the additional testing recommended by the PCP (Kangovi et al. 2013). On the other hand, at the emergency room, all the laboratory studies, the imaging studies, and specialty care can be obtained in one facility (Capp et al., 2015; Kangovi et al., 2013). Additionally, the PCP sometimes refer Medicaid patients to the ER due to higher illness complexity (MACPAC, 2014). Further, the ER may be more accessible to patients with low socioeconomic status because of the availability of ambulance services (Capp et al., 2016). Many of these patients do not have a vehicle and although Medicaid provides non-emergency medical transportation (NEMT), coordinating the transportation services with doctor's appointments can be challenging (Capp et al., 2016; Hall, Kurth, Shawna, Chapman, & Shireman, 2015). Other primary care barriers which inadvertently increase the indirect costs of primary care utilization for patients on Medicaid include: difficulty reaching the primary care team by phone or after-hours, delay in obtaining

appointments, and physical access barriers for patients with disabilities who are also highly prevalent in the Medicaid population (Drainoni et al., 2006; MACPAC, 2014). These barriers will likely lead to delay in obtaining primary care, poor outcomes, and increased need for high acuity care.

My main independent variable of interest is enhancing access to primary care through the provision of extended office hours at the usual source of care. In the conceptual framework described above, extended office hours can influence ER visits either through "perception of acuity/severity of disease" or through "availability of alternate sources of care." Provision of access to primary care through extended office hours can enhance regular and prompt chronic disease care leading to better outcomes and less likelihood of acute worsening of chronic diseases, thus preventing the need for emergency room care. Further, the provision of extended office hours at the USC provides an alternate source of care for non-emergent conditions in the evenings and weekends, further reducing ER visits. When after-hours care is provided at the usual source of care versus some other facilities such as urgent care centers or emergency rooms, it improves continuity and care coordination in primary care delivery (O'Malley et al., 2012). These two important attributes of primary care contribute to better outcomes in chronic disease management (Nelson et al., 2014; Rothman & Wagner, 2003).

Some factors in the model of ER utilization, including health insurance status, type of chronic condition, age, and perceived health status, are also likely to be associated with having a usual source of care who provides extended office hours. Insurance status may determine the options available to the patient. Privately insured patients usually have a larger network of providers to choose from, thus they may be more likely to have a provider with extended office hours.

In addition, age, the type of chronic condition, the presence of multiple chronic conditions, and perceived health status are likely to affect the value a patient places on potential access to the primary care team after hours. For example, an employed non-elderly adult patient with a diagnosis of asthma or COPD and poor perceived health status may likely place more value on extended office hours. Therefore, they may include the provision of extended office hours as a criterion when choosing their primary care provider.

Due to the unique challenges of the Medicaid population, it is probable that the provision of extended office hours at the usual source of care will not affect the likelihood of emergency room utilization in the Medicaid population to the same degree. To explore this idea, this study will also examine whether the association between the provision of extended office hours at the usual source of care and emergency room utilization differs by insurance status.

Conceptual framework for inpatient utilization and expenditures. Figure 2.2 below presents the conceptual framework for inpatient utilization. Apart from scheduled surgical procedures, most inpatient admissions start out as emergency room visits, thus the conceptual framework of inpatient utilization will be similar to that of emergency room utilization. However, since most conditions requiring inpatient admission are likely to be severe, "availability of alternate sources of care" and "cost of available options" as described in the conceptual model of ER visits above will not be applicable to inpatient utilization. Only the factors related to acuity or severity of health condition, including 1) whether the chronic disease is well-controlled, 2) the type of chronic disease, 3) the presence of multiple chronic conditions (multiple chronic conditions), 4) health literacy, 5) regular and prompt access to ambulatory care, 6) harmful health behaviors such as smoking, and 7) sociodemographic factors such as age, income, and race, as described in the conceptual framework for emergency room utilization

above, will be applicable in the conceptual framework of inpatient utilization and expenditures.

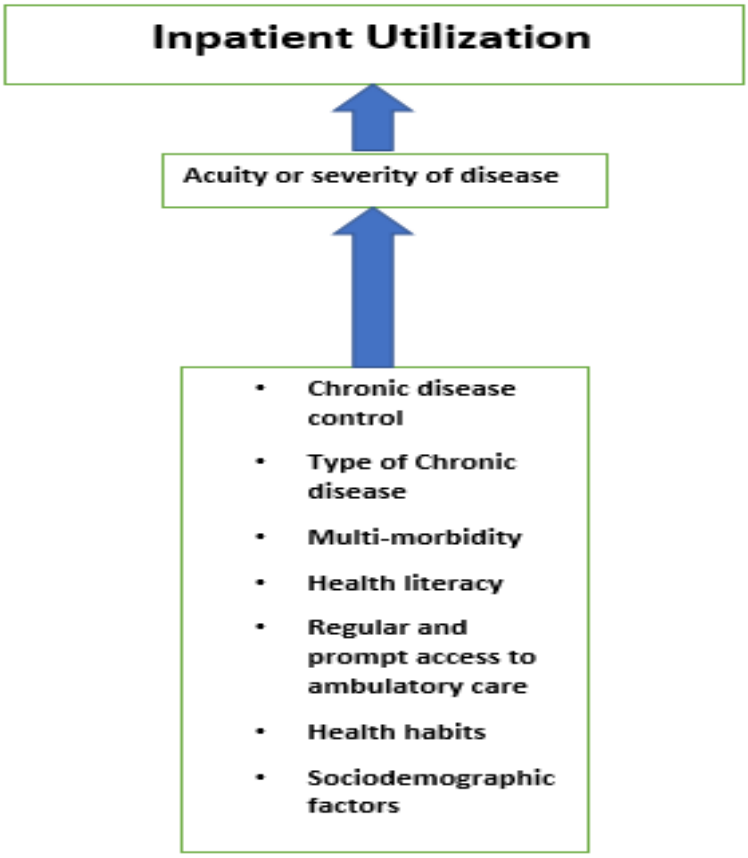

Figure 2.2: Conceptual Framework for Inpatient Visits

The main independent variable of interest- the provision of extended office hours at the usual source of care is expected to improve access to ambulatory care and improve continuity and care coordination by the PCP (Janke et al., 2015; O'Malley et al, 2013). There is increasing evidence that continuity of care and care coordination in primary care improve outcomes, including reduction in hospital admissions (Hussey et al., 2014; Menec, Sirski, Attawar, & Katz, 2006; Peikes, Chen, Schore, & Brown, 2009; Van Servellen, Fongwa, & Mockus D'Errico, 2006). Therefore, the provision of extended office hours is expected to be associated with a reduction in inpatient utilization.

Conceptual framework for primary care utilization. Figure 2.3 presents the conceptual framework for primary care visits. The basic model of primary care utilization in the population of adults with chronic ACSCs can be said to be of the form: PCP visit = F (need for care, factors enabling utilization).

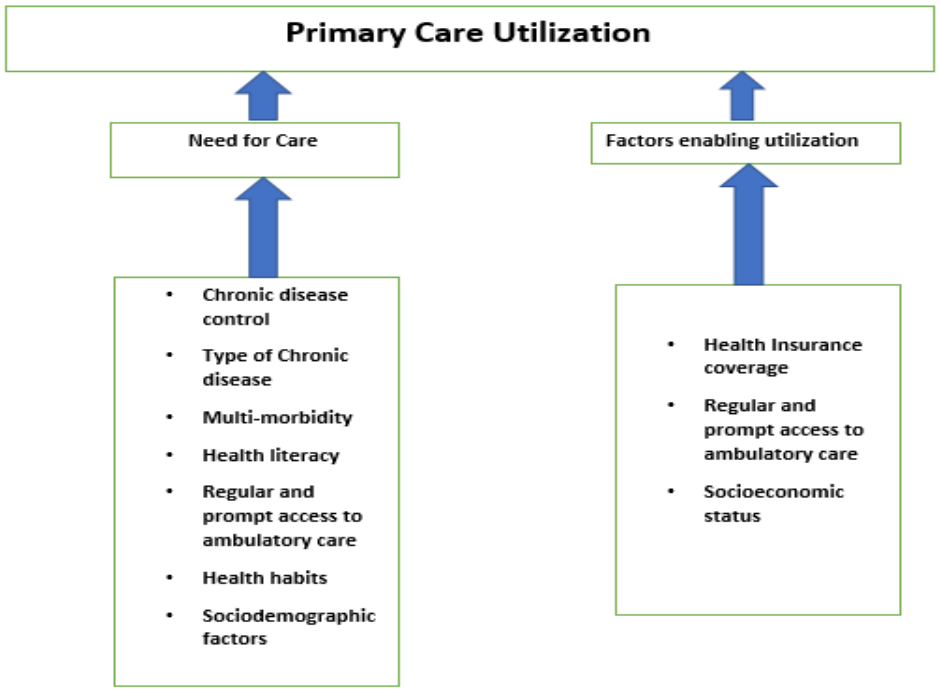

Figure 2:3: Conceptual Framework for Primary Care Visits.

Need for care. At a minimum, all adults with chronic ACSCs need to visit their PCP at least once a year. However, the likelihood of the need for more than one primary care visit a year may be affected by 1) whether the chronic disease is well-controlled, 2) the type of chronic disease, 3) the presence of multiple chronic conditions (multiple chronic conditions), 4) health literacy, 5) regular and prompt access to ambulatory care, 6) harmful health behaviors such as smoking, and 7) sociodemographic factors such as age, and race.

Patients with poorly controlled chronic diseases are likely to need more frequent primary care visits compared to those with well-managed disease. Further, certain types of chronic diseases such as asthma, COPD, and heart failure are more prone to acute exacerbations than

others, thus the type of chronic condition is also likely to affect the likelihood of more frequent primary care visits.

Similarly, as discussed in the conceptual model of emergency room utilization above, multiple chronic conditions, health literacy, age, race, and smoking are possible determinants of outcomes of patients with chronic conditions, thus these factors will likely affect the need for more than one annual primary care visit.

The main difference between the present model of primary care utilization and emergency room utilization is the role of access to primary care. Expanding access to primary care through the provision of extended office hours will probably result in more frequent primary care utilization as patients who would have otherwise utilized the ER for non-urgent conditions may utilize primary care instead.

On the other hand, the expansion of access to primary care through the provision of extended office hours may also prevent delay in seeking care for newly emerging conditions and therefore improve patient outcomes, thus further lead to a decreased need for frequent primary care visits. Therefore, the provision of extended office hours may be associated with an increase or decrease in primary care utilization. In the same vein, the provision of extended office hours in the context of the PCMH initiative may be associated with constant email and phone access. This may further reduce the need for frequent primary care visits because they offer an alternate way for patients to communicate with the provider without going in for a visit.

Factors enabling utilization. Upon establishing the need for care, factors such as health insurance and socioeconomic status are likely to be the major determinants of primary care utilization. There is some evidence from the literature that uninsured patients delay seeking care and sometimes go without needed care (Ayanian, Weissman, Schneider, Ginsburg, & Zaslaysky,

2000; Ross, Bradley, & Busch, 2006). Additionally, patients on Medicaid typically experience more primary care access barriers (Cheung et al., 2012; MACPAC, 2014) and have other challenges associated with low socioeconomic status, including transportation, which are likely to prevent them from seeking primary care (Capp et al., 2016; Cheung et al., 2012). Although Medicaid provides non-emergency medical transportation, some Medicaid beneficiaries report difficulties accessing these transportation services (Gordon, 2016), report that these services require some days' notice sometimes making it challenging to coordinate the transportation services with doctor's appointments (Capp et al., 2016; Hall et al., 2015), or report being sent vehicles that are not physically accessible (Hall et al., 2015). On the other hand, the ER is easily accessible through ambulance services. Other factors such as convenience and perception of the availability of higher healthcare quality in the hospitals compared to primary care offices (Capp et al., 2013, 2015; Kangovi et al., 2013) are also likely to result in lower primary care utilization by individuals with low socioeconomic status.

In summary, the conceptual frameworks of healthcare utilization and expenditures indicate that the provision of extended office hours at the USC will likely be associated with a reduction in ER visits, inpatient visits and total expenditures, and an increase or decrease in primary care utilization. The specific research questions of this dissertation and their proposed contributions are presented below.

Research Questions and Contributions

This dissertation aims to examine the provision of extended office hours at the usual source of care for the adult US population and seeks to determine whether the provision of extended office hours has any relationship with healthcare utilization and expenditures in the

population of US adults with chronic ACSCs. Specifically, the research questions and proposed contributions are stated below.

1. What is the proportion of US adults, with and without chronic ACSCs, who have a usual source of care providing hours in the evenings or during the weekend (extended office hours) and how has this changed over the past 10 years? Does this proportion differ by sociodemographic population characteristics?

   Contribution- Prior research has compared the proportion of primary care physicians who have an after-hours arrangement for their patients to see a provider without going to the ER across 11 developed nations and reports that the US comes last (Schoen et al., 2009a). Other researchers have utilized nationally representative data to describe trends in primary care access, including access to extended office hours, for children in the US (Ray & Mehrotra, 2016). No previous study has examined the prevalence and disparities of availability of extended office hours among the population of US adults with chronic ACSCs using nationally representative data. Results of this research will contribute to scholarly evidence on the prevalence and trends of timely access to primary care among the chronic disease population in the US. Additionally, the prevalence of access to extended office hours obtained in this study can serve as a baseline for comparison with future studies. Further, evidence of disparities in extended office hours would signal the need to intensify efforts at improving timely access to primary care for vulnerable populations.

2. What is the association between the provision of extended office hours at the usual source of care and measures of healthcare utilization and expenditures, including primary care

utilization, emergency room utilization, inpatient utilization, and total healthcare expenditures, in the population of US adults with chronic ACSCs? How does this association differ by insurance status?

Contribution- Prior research on this topic reports conflicting results and, no study has previously examined this association within the population of US adults with chronic ACSCs. Results of this study will contribute to scholarly evidence for the importance of timely access to primary care among the chronic disease population. This study will also impact policy and practice by encouraging payers to incentivize providers to offer extended office hours. Further, the results of this study will provide relevant information for policy discussions of regulating primary care office hours.

3. Are the observed associations between extended office hours and the measures of healthcare utilization and expenditures robust to allowing extended office hours at the USC and healthcare utilization and expenditures to be jointly determined?

   Contribution- Building on the second research question, this study will provide a methodological contribution. The use of a seemingly unrelated regression framework to jointly estimate the equations determining extended office hours and the healthcare utilization and expenditure variables while allowing for correlation of their error terms will likely mitigate residual bias in the regression models from question 2 above. This will further strengthen the veracity of the observed association between access to extended office hours and measures of health care utilization and expenditures. This study will be innovative because the evidence it provides will move the literature closer to drawing causal inference on

the effect of access to extended office hours and health care utilization and expenditures.

Chapter 3

Methods

Data Source

This dissertation used data files from the Medical Expenditure Panel Survey (MEPS) conducted by the Agency for Healthcare Research and Quality (AHRQ). The Household Component (MEPS-HC) of the MEPS collects data from a sample of families and individuals in selected communities across the United States, drawn from a nationally representative subsample of households that participated in the prior year's National Health Interview Survey.

During the household interviews, MEPS collects detailed information for each person in the household on the following: demographic characteristics, health conditions, health status, utilization of medical services, charges and source of payments, access to care, satisfaction with care, health insurance coverage, income, and employment.

The panel design of the survey, which features several rounds of interviewing covering two full calendar years, makes it possible to create lagged variables in the data analysis for the second and third question of this dissertation. This was done by modelling outcome variables in the second year of the panel conditioned on predictors in the first year of the panel, hence mitigating the possibility of simultaneity or reverse causation between the outcome and predictor variables. The data also contain weights which were used in the analysis to obtain nationally representative estimates.

The analysis for question 1 of this dissertation, which is a purely descriptive study to examine ten-year trends in the provision of extended office hours at the USC, utilized ten years' worth of data pooled from 2005 to 2014 full year consolidated data files of the household component of the medical expenditure panel survey (MEPS-HC). For questions 2 and 3, which

examined associations between dependent and independent variables, utilizing the 2-year longitudinal data files of the MEPS afforded the unique opportunity of lagging variables, that is, regressing dependent variables obtained from the second year of the survey on independent variables obtained from the first year of the survey. Therefore, for questions 2 and 3, the longitudinal data files of the MEPS-HC rather than the full year consolidated files were used. In addition, question 1 necessitated utilizing ten years' worth of data to examine trends over ten years. However, for questions 2 and 3, the analysis does not require 10 years' worth of data, it only needed a large sample size which was obtained by pooling data from 6 panels - panels 12 (2007-2008) to 17 (2012-2013). These data have been used in prior studies of the provision of extended office hours in primary care (Jerant et al., 2012b; Ray & Mehrotra, 2016).

Study Sample

The study sample for question 1 is a nationally representative sample of non-institutionalized US adults (aged 18 years and above) who participated in the MEPS between 2005 to 2014. To avoid overestimating the frequency distribution of the variables in the descriptive analysis for question 1, the "missing option" which treats missing values as a separate category, was utilized. For example, in the estimation of the proportion of all US adults with a USC offering extended office hours, utilizing the "missing option" for the frequency distribution yielded 8.18%, 25.56%, 40.96%, and 25.57% for those who responded, "don't know", "yes", "no" and those with missing values respectively. Without utilizing the "missing option" the frequency distribution yielded 10.95%, 34.21%, and 54.82% for responses, "don't know" "yes", and "no" respectively.

The aim of the second and third research questions of this dissertation is to examine the association between the expansion of access to primary care through the provision of extended

office hours at the usual source of care and measures of healthcare utilization and expenditures among adults with chronic ambulatory care sensitive conditions. Therefore, the study sample for questions 2 and 3 was restricted to adults who had a diagnosis of a chronic ambulatory care sensitive condition (angina, heart failure, asthma, COPD, diabetes, or high blood pressure) and who reported having a usual source of care. In addition, because the emergency room should be a source of acute care and not a regular source of care, those who reported having the emergency room as a usual source of care were excluded from the analysis. A total of 68,676 adults participated in panels 12 to 17 of the MEPS. Out of these, 38,868 had one or more chronic ACSC. Further, only 24,4440 had a usual source of care other than the emergency room, and 2,939 of these had missing values, leaving 21,501 in the final analytic sample.

To ensure that weights were properly used in the computation of standard errors, the subgroup option was used to specify the sub-sample of study participants who satisfied my inclusion criteria (adult aged 18-85 years, diagnosis of a chronic ACSC, and reported having a USC, and had no missing value in all regression variables) within the broader survey sample. More specifically, the regression models for questions 2 and 3 were estimated using all observations in panels 12 to 17 of MEPS longitudinal data files to fully account for sample weights, but with a "sub-population" option to restrict the analysis to the sub-sample.

Variable Specifications

Dependent variables. As noted earlier, my conceptual model indicates that the provision of extended office hours at the USC is likely to be associated with improved patients' outcome, including a reduction in both the intensity and likelihood of any emergency room and inpatient utilization and a reduction in total healthcare expenditures. Additionally, the conceptual model indicates that the provision of extended office hours at the USC may either increase or decrease

primary care utilization. To investigate these associations, the dependent variables specified in this study include emergency room visits, inpatient visits, primary care visits, and total annual healthcare expenditures. To create a lagged effect and ensure temporality between the dependent and independent variables, the dependent variables were obtained from the second year of each panel of the MEPS longitudinal data files.

The health care utilization variables were specified in the analysis as both count and binary variables. The count variables were used to investigate whether the provision of extended office hours at the USC had any effect on the intensive margin (intensity) of each type of healthcare utilization while the binary variables were used to investigate the association between extended office hours at the USC and the extensive margin (the likelihood of any use) of each type of healthcare utilization.

The count variables were specified as the number of primary care visits, the number of emergency room visits, and the number of inpatient visits in a year. The binary measures indicated having at least one visit in a year for emergency room visits and inpatient visits. However, as indicated in the conceptual model, it is expected that all adults with chronic ACSCs who have a usual source of care will utilize primary care at least once a year regardless of whether the USC provides extended office hours. On the other hand, the likelihood of having more than one primary care visit may be increased with the provision of extended office hours because of the potential diversion of patients who would have otherwise utilized the ER after-hours to the primary care office, therefore the binary measure of primary care utilization was specified as indicating more than one primary care visit in a year.

The number of emergency room visits, and inpatient visits were obtained directly from the longitudinal data files of the MEPS-HC. However, the longitudinal files only provided

information on the number of office-based provider visits and the number of outpatient provider visits. To determine the number of visits to the primary care providers, the longitudinal data files were merged with the outpatient visits and office-based medical provider visits event-level files which provided information on the specialty of the provider seen at each visit. Any outpatient or office-based visit was coded in this analysis as a primary care visit if the specialty of the provider was reported as family practice, general practice, geriatrics, or internal medicine.

As indicated in the conceptual model in chapter 2 of this dissertation, the provision of extended office hours at the USC is likely to improve chronic disease outcomes through enhancing the continuity and care coordination functions of primary care, and hence reduce the need for acute care utilization and total healthcare expenditures. Total annual healthcare expenditure was defined in the MEPS as the sum of all direct payments for all forms of health care provided in the year. It excludes payments for over the counter medications. Data from 2007 to 2013 were pooled for analysis; to ensure comparability, expenditures were adjusted to 2013 US dollars using the overall Personal Health Care index (Agency for Healthcare Research and Quality, 2016, Table 3).

Independent Variables. The main independent variable of interest in this dissertation is the provision of office hours at night or on the weekend (extended office hours) by the usual source of care. It was operationalized using the MEPS variable "OFFHOU2" in the first year of each panel which asks, "DOES USC (usual source of care) HAVE OFFICE HRS AT NIGHT/WKEND?" The responses to this question in the MEPS data were "yes", "no", "don't know", "not ascertained", "refused", and "inapplicable". For the regression models in questions 2 and 3, only "yes" and "no" were considered valid responses. Other responses were re-coded as missing and dropped from the analytic samples for questions 2 and 3. Sensitivity analysis using

three categories of extended hours ("yes", "no", and "don't know) was also conducted.

The variable on extended hours only provides information on whether the USC provides office hours at night or weekend without specifying how many hours outside of regular business hours were provided. Consequently, this study was only able to explore the association between a binary measure of extended office hours (the provision of any evening or weekend hours) but unable to determine the dose-response relationship between the provision of extended office hours at the USC and healthcare utilization and expenditures.

Covariates for questions 2 and 3. The main objective of questions 2 and 3 is to obtain an unbiased estimate of the relationship between the provision of extended office hours at the USC and healthcare utilization and expenditures. Consequently, determinants of health care utilization and expenditures indicated in the conceptual framework to also have a conceptual relationship with the provision of extended office hours at the USC were included in the most parsimonious regression models as covariates. These covariates include age, health insurance coverage, perceived health status, type of chronic disease, level of education, and region of study participant's residence. Failure to include these covariates in the regression models will likely result in a biased estimate of the association between the provision of extended office hours and healthcare utilization and expenditures. In addition, factors including race, sex, and smoking status which are conceptually related to healthcare utilization and expenditures but not likely to be associated with the provision of extended office hours at the USC were included in subsequent regression models to improve the fit of the models.

As indicated in the conceptual model, age-related physiologic changes, and a greater degree of frailty with age are likely to contribute to increased burden and complexity of chronic conditions with increasing age (Anderson, 2010; National Council on Aging, 2015), therefore

older individuals are likely to need more primary care and will probably be more susceptible to developing acute conditions requiring emergency room and inpatient care. Likewise, the distribution of the provision of extended office hours at the USC is likely to vary with age as nonelderly working adults may value the flexibility of seeing their primary care provider after hours more than elderly adults who are likely unemployed. Age was measured in the MEPS data as a continuous variable top-coded at 85 years. However, it is unlikely that a unit increase in age will be associated with a meaningful change in the need for healthcare. For example, a 36-year-old will likely not differ from a 37-year-old in their need for healthcare. Consequently, the relationship between age and healthcare utilization or expenditures is likely not linear. Rather, individuals are likely to be different in the need for healthcare based on age categories. For example, adults aged 18-35 years are likely to differ from those aged 36-55 years in their need for healthcare. Therefore, age was specified as a categorical variable in the regression models for this study. The age groups included in the regression models were 18-35 years, 36-55 years, 56-64 years, 65-75years, and 76-85 years. The youngest age group ("18-35 years") was the reference category. These categories were chosen based on my expectations of similarities in these age groups' healthcare utilization and expenditures, which were also explored and verified in the data. Sensitivity analyses specifying age as a continuous variable and also including a squared term in the regression model were also conducted.

There is extensive evidence in the literature linking health insurance to healthcare utilization and expenditures (Aron-Dine, Einav, & Finkelstein, 2013; Card, Dobkin, & Maestas, 2008; Freeman, Kadiyala, Bell, & Martin, 2008). Health insurance coverage offers potential access to healthcare; hence it is likely that uninsured individuals will use less healthcare and have less healthcare expenditure. Further, there is evidence in the literature indicating that

individuals on public insurance (Medicaid or Medicare) have higher healthcare utilization and expenditures than privately insured individuals (LaCalle & Rabin, 2010; Shi, 2000; Sommers, Boukus, & Carrier, 2012). In addition, as indicated in the conceptual model, privately insured individuals are more likely to have providers who offer extended office hours because they have a larger network of providers to choose from. Because health insurance coverage is both related to the outcome and independent variable, it is likely to bias the estimate of the association between extended hours and healthcare utilization and expenditures. To obtain an unbiased estimate of the effect of extended hours on the outcome variables in this study, health insurance coverage was included in the regression models as a covariate. Health insurance was specified in the MEPS data as a categorical variable with categories: "any private insurance", "only public insurance", and "uninsured". The "only public insurance" category includes those on Medicaid or Medicare without private supplemental plans. Private insurance was chosen as the reference category.

As indicated in the conceptual model, there is increasing evidence supporting an association between low health literacy and poor outcomes, including ER utilization and poor health status (Bennett, Chen, Soroui, & White, 2009; Berkman, Sheridan, Donahue, Halpem, & Crotty, 2011; DeWalt, Dilling, Rosenthal, & Pignone, 2007; Griffey, Kennedy, McGownan, Goodman, & Kaphingst, 2014). Although the medical expenditure panel survey (MEPS) does not measure health literacy, it measures years of education of the participants. There is increasing evidence indicating that health literacy is a mediator of the association between education and patient outcomes (Davis et al., 2006; Schillinger, Barton, Karter, Wang, & Adler, 2006; van der Heide et al., 2013). Therefore, education will be utilized as a marker of health literacy in this study.

Education is measured in the MEPS data as years of education. It is unlikely that the relationship between education and patient outcomes is linear since there is likely not much difference in knowledge and skill acquisition with every additional year of education. Consequently, in the present study, the educational status of the study participants will be specified as a categorical variable with categories "less than high school education" "completed high school education" and "some college education". Individuals who have some college education are likely to be different from those with less than high school education or those who only completed high school in their ability to comprehend health-related information. Completion of a college degree was not included as a separate category in the analysis because the study population included adults aged 18 years or more, some of which just started college and will be completing their college degree in two or three years. Including completion of college as a separate category in the regression models will wrongly classify adults who would have gone on to complete a college degree in the future as not having a college degree. Further, the information being captured by the education variable is the ability of patients to understand, interpret and correctly utilize health information which will not likely be different for an individual who has some college education versus those who completed college.

Further, as indicated in the conceptual model, individuals with poorly-controlled disease are likely to have higher healthcare utilization and expenditures. Although there is no variable in the MEPS data providing explicit information on poor control of chronic conditions, the MEPS data provides information on self-reported health status which is graded on an ordinal scale (excellent, very good, good, fair, poor). This information was recoded to create a binary measure indicating poor self-reported health status which was incorporated into the regression models as a proxy for poorly controlled disease.

The study population for questions 2 and 3 of this dissertation is US adults diagnosed with one or more chronic ambulatory care sensitive condition (angina, chronic heart failure, asthma, COPD, diabetes, and high blood pressure). As indicated in the conceptual model, due to differing severity and course, the specific type of chronic diseases is likely to be associated with healthcare utilization and expenditures. Therefore, an indicator variable for each of the chronic condition was included in the regression models. One of the indicator variables for the chronic conditions (high blood pressure) was excluded from the models due to multi-collinearity.

In addition, the indicator variables for each type of chronic condition in the regression models serve the dual purpose of controlling for multiple chronic conditions. Another way to control for the presence of multiple chronic conditions would have been to use a count variable indicating the number of chronic conditions or a binary variable indicating whether the study participant had more than one chronic condition. However, including any of these two variables (the count or indicator variable) in addition to controlling for each of the specific chronic conditions is likely to result in over-adjustment or collinearity because the information provided by these variables has also been provided by including an indicator variable for each of the chronic conditions. For instance, a study participant who has a value of "1" on the high blood pressure and COPD variables, also has 100% chance of having a value of "1" on the comorbidity binary variable and 100% chance of having a count of "2" on the number of chronic disease variable. Consequently, because these two variables that would have additionally captured the effect of multiple chronic conditions in the regression models are too closely related to the indicator variables for each of the chronic conditions, they were not included in the models. In sensitivity analyses, these two variables (the binary indicator for comorbidity and the count

variable for number of chronic diseases) were included in the regression models, and they did not significantly change the estimates on the effect of extended hours.

Additionally, the relationship between the provision of extended office hours at the USC and healthcare utilization and expenditures were explored for each chronic ACSC subpopulation. The subpopulation regression analyses by type of chronic conditions controlled for all the covariates in the original models, including other chronic conditions. For example, the regression model for the subpopulation of adults with high blood pressure also controlled for other types of chronic conditions including asthma, COPD, heart disease, and diabetes. These chronic conditions were included as covariates in the subpopulation analyses by type of chronic condition because almost half of the study sample had more than 1 chronic condition and it is likely that the presence of a comorbidity will affect the likelihood or intensity of healthcare utilization. For instance, in the subpopulation of individuals who have high blood pressure, the probability of ER utilization will likely be higher for those who also have COPD compared with those who do not.

To control for the effect of race, an indicator variable for non-Hispanic Blacks was included in the models. Non-Hispanic Blacks generally have a higher prevalence of chronic conditions and poorer outcomes than other racial and ethnic groups (Bulgar et al., 2012; Fayfman et al., 2016; Hayward, Miles, Crimmins, & Yang, 2000).

Unhealthy behaviors, including smoking, have been shown to be associated with poor chronic disease outcomes (CDC, 2008), therefore individuals who smoke may have higher healthcare utilization and expenditures. Binary variables indicating current smoking status (yes or no) were included in the regression models as covariates.

Finally, the census region (Northeast, Midwest, South, & West) of each study participant's residence was also included in the model. Although the conceptual model did not indicate a probable relationship between the region of participant's residence and healthcare utilization and expenditure, there is evidence from the literature suggesting regional variation in healthcare utilization and expenditures (Fisher, Bynum, & Skinner, 2009; Zhang, Baik, Fendrick, & Baicker, 2012). Further, the frequency distribution of the provision of extended office hours at the USC shows significant variation by census region of study participant's residence.

These covariates were assessed in the first year of each panel in the data. For those factors prone to change within the year the respondents' status as at the end of the year was reported in the MEPS data.

Sociodemographic characteristics used for question 1. Question 1 was a purely descriptive analysis to examine the trends in the provision of extended office hours at the USC, hence the choice of sociodemographic characteristics used was not guided by a conceptual model. Rather, population characteristics commonly used in the literature and available in the data were used to describe the frequency distribution of the provision of extended office hours. These sociodemographic characteristics include age, elderly adult, sex, race/ethnicity, US census region, education, health insurance, household income, marital status, and employment status.

Age of study participants was specified as a categorical variable with categories 18-25 years, 26-35 years, 36-45 years, 46-55 years, 56-65 years, 66-75 years, and 76-85 years.

Race and ethnicity were originally measured in the MEPS data as six race categories (White, Black, American Indian/Alaska Native, Asian, Native Hawaiian, and Multiple races reported), and Hispanic versus non-Hispanic. These were collapsed into Non-Hispanic Whites,

Non-Hispanic Blacks, Hispanics, and Other races (Asian, American Indian/Alaska Native, Native Hawaiian, and those who reported multiple races).

US Census region of the study participants' residence was reported in the MEPS data as one of four categories: Northeast, Midwest, South, and West. These were utilized in the analysis as originally recorded in the data. Other variables utilized as originally specified in the MEPS data include health insurance coverage, and sex (male/ female). Health insurance coverage variable has three categories: any private insurance, only public insurance (Medicaid or Medicare without supplemental private plans), and uninsured.

Marital status was reported in the MEPS data as 5 categories: married, widowed, divorced, separated, never married. These were collapsed into 4 categories in which divorced and separated were put in one category. Employment status had 4 categories which were collapsed into a binary variable indicating employment or no employment.

Other sociodemographic characteristics used to describe the frequency distribution of the provision of extended office hours at the USC were household income and education. Household income as percentages of the federal poverty line (FPL) were presented in the MEPS data as categories: poor / negative (<100% FPL), near poor (100-125%), low income (125-200%), middle income (200-400% of FPL), and high income (≥400% of FPL). These were collapsed into 4 categories by combining the near poor and low-income categories in the present analysis. Similar to the specification for questions 2 and 3, education was specified as a categorical variable with categories: "less than high school", "completed high school" and "≥ 1year of college".

Statistical Analysis

Question 1. The objective of the first question of this dissertation is to provide a

descriptive analysis of the provision of extended office hours within the last 10 years, among US adults and especially among those with chronic ACSCs.

The characteristics of the study population were described using frequency distributions for dichotomous or categorical variables and means and medians for continuous variables. This was done first for all adults, then separately for adults with and without chronic conditions. Differences in population characteristics based on presence or absence of chronic conditions was also examined using chi-square statistics for categorical variables and t tests for continuous variables, with the level of statistical significance set at 5%. Results are presented in Table 4.1 in chapter 4 of this dissertation.

The proportion of having a usual source of care that provided extended office hours was examined using frequency distributions. Differences in having a USC providing extended office hours by population characteristics was tested using chi-square statistics. Level of significance for all analyses was set at the 5% level. Results of this analysis are presented in Table 4.2, in chapter 4 of this dissertation.

Trends in having a USC and trends in having a USC providing extended office hours were examined for all adults, and for adults with and without a chronic ACSC. This was done by calculating frequencies within each year from 2005 to 2014, then presenting the frequencies with the aid of a line chart. Differences in the proportion of having a USC or USC providing extended office hours by year was also tested with chi-square statistics, with the level of significance set at 5%. Results are presented in Figures 4.1 and 4.2 in chapter 4 of this dissertation.

Trends in having a USC providing extended office hours were further examined within categories of select population characteristics including health insurance coverage, elderly adult, and US census region of study participant's residence. The analysis of trends by these population

characteristics was done because of differences in the prevalence of extended hours by these population characteristics. The differences in prevalence by these population characteristics indicated that it might be interesting to explore the trends in extended hours within categories of these population characteristics. Results of this analysis are presented in figures 4.3, 4.4, and 4.5 of chapter 4.

Question 2. As indicated in the conceptual model in chapter 2 of this dissertation, the provision of extended office hours at the USC is expected to be associated with lower ER utilization, lower inpatient utilization, and lower total annual healthcare expenditures. However, for primary care utilization, the conceptual model indicated that the provision of extended office hours at the USC could lead to an increase or decrease in primary care utilization. To investigate these associations, the aim of the second research question of this dissertation was to obtain an unbiased estimate of the relationship between the provision of extended office hours at the USC and the three types of health services utilization and total annual healthcare expenditures. Further, the conceptual model indicated that these relationships may differ by health insurance coverage. Therefore, this study further examines the association between the provision of extended office hours and healthcare utilizations and expenditures by health insurance coverage.

As stated earlier, both the extensive and intensive margins of ER utilization, inpatient utilization, and primary care utilization were examined in this study. The extensive margins were specified as three binary variables indicating at least one visit for ER and inpatient utilization, and more than one visit for primary care utilization. The intensive margins were specified as three count measures indicating the number of primary care visits, number of ER visits, and number of hospital admissions. This study also examined total annual healthcare expenditures, which was expressed in 2013 dollars to ensure comparability across the several years of data

pooled for analysis.

Logistic regression models. Association between extended office hours and binary measures of healthcare utilization were examined using binary logistic regression models. This regression model is appropriate given the dichotomous nature of these dependent variables. Binary logistic regression utilizes a maximum likelihood estimation technique to estimate the probability of a positive outcome (dependent variable equals 1) given a set of regressors (Agresti, 2002; Hilbe, 2011a). The beta coefficients of the regressors (independent variables) represent the change in the log-odds of a positive outcome with a unit change in the regressor when other regressors are kept constant (Kleinbaum & Klein, 2010). Exponentiated forms of the beta coefficients represent the ratios of the odds of a positive outcome with a unit change in the independent variable. This dissertation reports the exponentiated coefficients. The results of the binary regression models in this dissertation are presented in tables 4.4, 4.5, & 4.6 of chapter 4 as odds ratios. All models were estimated using weights to account for the survey design of the MEPS data.

The effect of the provision of extended office hours on each of the three binary measures of healthcare utilization in this dissertation was examined using three binary logistic regression models for each measure. The first model was the unadjusted model which did not control for covariates. The second model adjusted for the minimum covariates (age, health insurance, education, poor perceived health status, chronic condition indicators, and census regions) that are expected to bias the estimate of the association between the dependent and independent variable (as discussed in the conceptual model of chapter 2 above). The third model included additional covariates (sex, race, and current smoking status) to improve the fit of the model.

The three binary regression models were estimated to assess how covariates affect the

association between the dependent and independent variable. The change in the estimate of the effect of extended office hours in the first and second models was higher than 10%, confirming that the covariates included in the second model are indeed confounders that need to be included in the model to obtain an unbiased estimate of the effect of extended office hours. The 10% rule is commonly used as a cutoff to identify potential confounders in a regression model (Budtz-Jorgensen, Keiding, Grandjean, & Weihe, 2007; Maldonado & Greenland, 1993; Mickey & Greenland, 1989).

The difference in the odds ratios obtained for extended office hours in the second and third models was not up to 10%. This confirms that the covariates added to model 3 were not necessary to obtain an unbiased estimate of the association between extended office hours and measures of healthcare utilization. However, the pseudo R squared, the Akaike Information Criteria (AIC) and the Bayesian Information Criteria (BIC) from the third model were higher than those of the second models suggesting that the third models are better.

Regression diagnostics were performed to ensure the models have a good fit and to test for multi-collinearity in the covariates. All models fit the data well with p values of greater than 0.05 for the Hosmer-Lemeshow goodness of fit which tests the null hypothesis of good fit; p values of greater than 0.05 provides insufficient evidence to reject the null hypothesis of a good fit. One of the 5 indicator variables for chronic condition diagnosis (high blood pressure) was dropped from the analysis due to multi-collinearity. Results of the tests for multi-collinearity and goodness of fit are not presented in this dissertation but are available upon request.

In addition to estimating binary logistic regression models of ER utilization for the study population of adults with chronic ACSCs, this dissertation also estimated binary logistic regression models of ER utilization by sub-populations based on the type of chronic condition.

That is, five different binary logistic regression models were estimated, one for each sub-population with a diagnosis of high blood pressure, asthma, COPD, heart disease, and diabetes. The results of these models are presented in table 4.4b of chapter 4. However, these sub-population analyses were not conducted for other measures of healthcare utilization and expenditures due to small sample sizes in these sub-populations.

Hurdle Poisson regression models. The count measures of healthcare utilization (the number of ER visits, the number of hospital admissions, and the number of primary care visits) were estimated using hurdle Poisson regression models. Hurdle Poisson regression first estimates the probability of a non-zero count using a logit or probit regression, then estimates the expected log counts among those with a non-zero count using a truncated Poisson or Negative Binomial model (Mullahy, 1986).

Count regression approaches are appropriate to model these count measures of healthcare utilization (Cameron & Trivedi, 2013; Coxe, West, & Aiken, 2009). The standard count regression model is a Poisson regression. However, due to the nature of healthcare utilization in which there are usually many non-utilizers and very few high utilizers, the data had many observations with a count of zero on these dependent variables. For example, more than 80% of the study participants in the present study had zero ER visits. Such occurrence of zero counts is higher than expected for the Poisson distribution which requires the mean to be identical to the variance (Hua, Wan, Wenjuan, & Paul, 2014; Ridout, Demetrio, & Hinde, 1998).

Count data with a high occurrence of zeros have been modelled in the literature using zero-inflated count regression models or hurdle count regression models (Hilbe 2011b; Hu, Pavlicova, & Nunes, 2011; Mihaylova, Briggs, O'hagan, & Thomson, 2011). Zero-inflated models, introduced by Lambert (1992), assume that there are two unobserved groups in a

population with count data: those who have a 100% probability of having a zero count, and those who may have a zero count but also have some probability of having a non-zero count (Long & Freese, 2006). This results in two different origins of the zero counts observed in count data, "excess zeros" and "real zeros." Excess zeros are those which arise from assessing for an outcome in study participants who are not at risk for the outcome while real zeros are zero outcomes observed in study participants who are at risk for the outcome (Ridout et al., 1998).

The zero-inflated regression models the count response as a mixture of two distributions, one of "excess zeros" from those who are not at risk of having the outcome, and the other of responses (both non-zero counts and "real zeros") from those who are at risk of having the outcome (Hua et al., 2014). The first distribution is modelled using a binary logit or probit model while the second distribution is modelled using a Poisson or Negative Binomial model.

On the other hand, the hurdle count regression models assume that all the observed zero counts in the data are "real zeros" (Atkins, Baldwin, Zheng, Gallop, & Neighbors, 2013). In contrast to the zero-inflated models where some of the study participants have a 100% probability of having a zero count, in a hurdle model, no individual has a 100% chance of having a zero count because everyone is at risk of having the outcome. All study participants have a non-zero probability of having zero or non-zero counts. The zero counts observed in the measures of healthcare utilization in this dissertation are "real zeros" because everybody is at risk of utilizing healthcare.

Although both the hurdle and zero-inflated models each estimate two equations, they differ in some ways. First, in the zero-inflated models, the binary logit or probit models estimates the probability of not being at risk for the outcome (that is, the probability of having excess

zeros), while, in the hurdle Poisson models, it estimates the probability of having a non-zero count, that is, the probability of crossing the hurdle (Atkins et al., 2013). Second, in the zero-inflated models, the second component is a regular Poisson or Negative Binomial which estimates the distribution of both zero and non-zero counts; in the hurdle models, the second component is a truncated Poisson or Negative Binomial which estimates the expected count among those with a non-zero count (Moineddin, Meaney, Agha, Zagorski, & Glazier, 2011).

Considering the description of the hurdle and zero-inflated models above, the hurdle Poisson approach was chosen to model the count measures of healthcare utilization examined in this dissertation. This approach has been previously used in the literature to estimate measures of healthcare utilization (Mihaylova et al., 2010; Moineddin et al., 2011). The beta coefficients reported by the hurdle Poisson models represent the log odds of having a non-zero count in the binary logit model and the log expected counts in the truncated Poisson model. Exponentiated forms of these coefficients represent odds ratios and incidence rate ratios respectively. The exponentiated coefficients are reported in tables 4.4, 4.5, & 4.6 of chapter 4.

Regression diagnostics were performed to ensure that the models have a good fit. All models fit the data well with p values of greater than 0.05 for the Hosmer-Lemeshow goodness of fit tests. Results of regression diagnostics are not presented but are available upon request.

Linear regression models. The association between healthcare expenditures and provision of extended office hours by the usual source of care was examined using three different linear regression models: ordinary least square (OLS) regression model of the untransformed variable, OLS regression of the log-transformed variable, and a median regression estimating the conditional median of the expenditure variable.

One of the assumptions of the OLS is that of normality. The distribution of the total

annual healthcare expenditure variable in this dissertation was non-normal with a large right tail. One of the ways to make data more normally distributed is log-transformation, hence the expenditure variable was log-transformed in the present study. A value of 1 was added before log transformation because of observations with zero expenditures. OLS regression models of both the transformed and untransformed expenditure variables are presented in table 4.7 of chapter 4.

Another approach to modelling highly skewed continuous data in the literature is to utilize the median regression which regresses to the median (Bang & Tsiatis, 2002; McGreevy, Lipsitz, Linder, Rimm, & Hoel, 2009). The median is usually more resistant to the effects of extreme values in continuous data. The median regression has also been previously used to model healthcare expenditures in the MEPS data (Chen, Vargas-Bustamante, Mortensen, & Thomas, 2014). The results of the median regression model are also presented in table 4.7.

Generalized linear models (GLM) with log link and Poisson or gamma distributions have also been used in the literature for skewed continuous data such as healthcare expenditures (Hill & Miller, 2010; Jerant et al., 2012b; Stockbridge, Philpot, & Pagan, 2014). These two types of generalized linear models were also utilized to model the healthcare expenditure variable in this dissertation. Both models showed comparable results to the other linear models presented above. Results from these two models are not presented in this dissertation but are available upon request.

Question 3. Despite adjusting for covariates that are jointly related to the dependent and independent variables in the regression models of question 2 above, there remains the possibility of unobserved factors that jointly affect an individual's probability of choosing a provider that offers extended office hours and their healthcare utilization and expenditures. This may manifest as a correlation between the error terms of the equations determining extended office hours on

one hand, and healthcare utilization and expenditures on the other.

The third question builds on question 2 by utilizing seemingly unrelated regressions (SUR) to estimate the models in question 2 above. Seemingly unrelated regressions allow for two or more equations to be jointly estimated as well as allow their error terms to be correlated (Moon & Perron, 2006; Zellner, 1962). Jointly estimating and allowing for correlation of the error terms of the equation determining extended office hours on one hand, and the equation determining healthcare utilization and expenditures on the other will serve to mitigate some of the bias from the unobserved factors that jointly determine the dependent and independent variables in question 2 of this dissertation.

The SUR models were used to examine only associations that were found to be statistically significant in the second research question of this dissertation. These SUR models were estimated using the Stata conditional mixed process (CMP) estimator developed by Roodman (2011). The CMP estimator was not built to handle binary logistic regressions, quantile regressions, and Poisson regressions. Therefore, the binary logistic models in question 2 above were estimated using binary probit regression. Further, due to the inability of the CMP estimator to handle median regressions, only the OLS regression equations of the log-transformed total annual expenditures were further examined in question 3. The results of the single equation models in question 2 and the seemingly unrelated regression models of question 3 are presented side by side in table 4.8 to allow for visual comparison of both results.

Chapter 4

Results

The objectives of the research questions of this dissertation are to examine trends in enhanced access to primary care, in the form of provision of extended office hours, and to assess its effects on healthcare utilization and expenditures among individuals with chronic Ambulatory Care Sensitive Conditions (ACSCs). This chapter presents the findings of the dissertation.

These findings are organized according to the research questions. The aim of the first research question is to examine the trends in the provision of extended office hours within the last 10 years among US adults with and without chronic ACSCs. The second question examines the association between the provision of extended office hours and healthcare utilization and healthcare expenditures in the population of adults with chronic ACSCs. It further examines whether this association differed by insurance status. The third question builds upon question 2 by assessing whether differences in utilization and costs are attributable to extended office hours or differences in patient characteristics. Specifically, question three analysis utilizes a seemingly unrelated regression framework to account for unobservable endogenous factors that affect both access to extended office hours and health care utilization and expenditures.

Question 1: Trends in the Provision of Extended Office Hours among US Adults from 2005 To 2014

Study population. The Medical Expenditure Panel Survey (MEPS) data between 2005 and 2014 had 347,939 observations out of which 233,795 were adults aged 18-85 years (age is top-coded in the MEPS data). Table 4.1 presents weighted descriptive statistics for adult MEPS participants.

As indicated in column 1, the weighted mean age of adult MEPS respondents was 46.45 (95% confidence interval (46.16, 46.74), linearized standard error, 0.15). Approximately 1 in 6 (17.5%) adult MEPS participant were aged 65 or more (elderly adults). About half (52%) were females, most (36.74%) lived in the South, 18.41% in the Northeast, 21.7% in the Midwest and 23.15% in the West. Half (50.77%) of the adult US population had at least some college education, 27.03% completed high school, and 16.10% had less than high school education. Based on poverty level categories calculated using family income as a percent of the federal poverty line, 11.89% were categorized as poor or having negative income, 17.67% were near poor or had low income, 30.26% were middle income, and 40.18% were categorized as having a high income. All statistics were calculated using survey weights.

Out of the 233,795 adults in the MEPS between 2005 and 2014, 98,041 (42.77%) had at least one chronic condition designated by the AHRQ as an ambulatory care sensitive condition (angina, heart failure, asthma, chronic obstructive pulmonary diseases, diabetes, or hypertension), see column 2 of table 4.1. Adults with chronic ACSCs were older with a mean age of 55.52 years (95% CI: 55.17, 55.87) compared to 39.68 years (column 4, table 4.1) for those without chronic ACSCs. In addition, column 2 of table 4.1, which presents the proportion of each population subgroup having chronic ACSCs, shows those in the older age categories having a higher prevalence of chronic ACSCs. Approximately 8 in 10 adults aged 76-85 years have at least one chronic ACSCs. Compared to the population of adults without chronic conditions, adults with chronic conditions had similar sex, race/ethnicity, census region, education, and income level categories (see columns 3 and 4 of table 4.1). On the other hand, the population of adults with and without chronic ACSCs differed greatly in their frequency distribution of marital status and employment status. Compared with adults without chronic

ACSCs, those with chronic ACSCs had a significantly higher percentage of being widowed and being unemployed (see columns 2 and 3 of table 4.1). This is likely linked to the age differences in those with and without chronic ACSCs. Adults with chronic ACSCs are older and therefore more likely to be widowed and unemployed because of retirement or illness.

Table 4.1: Major Characteristics of US adults with and without chronic ACSCs

Population Characteristics		Percent Distribution of All US Adults (S.E) N= 233,795	Percent with chronic ACSCs (S.E)	Percent Distribution of US adults with chronic ACSCs (S.E) N= 98,041	Percent Distribution of US adults without chronic ACSCs (S.E) N= 135,754
Total		100	42.77 (0.281)	100	100
Age Categories	18-25 years	14.53 (0.002)	16.74 (0.369) ***	5.69 (0.001)	21.14 (0.003)
	26-35 years	17.58 (0.002)	21.85 (0.378)	8.98 (0.002)	24.00 (0.003)
	36-45 years	17.64 (0.002)	31.71 (0.446)	13.08 (0.002)	21.05 (0.002)
	46-55 years	18.80 (0.002)	45.72 (0.451)	20.10 (0.003)	17.83 (0.002)
	56-65 years	15.21 (0.002)	62.27 (0.465)	22.14 (0.003)	10.03 (0.002)
	66-75 years	9.04 (0.001)	75.94 (0.508)	16.05 (0.002)	3.80 (0.001)
	76-85 years	7.20 (0.002)	82.93 (0.492)	13.96 (0.004)	2.15 (0.001)
Elderly Adult		17.50 (0.003)	78.51 (0.373) ***	32.12 (0.005)	6.57 (0.002)
Sex	Male	48.30 (0.001)	42.27 (0.331) *	47.74 (0.003)	48.72 (0.002)
	Female	51.70 (0.001)	43.23 (0.342)	52.26 (0.003)	51.28 (0.002)
Race/ethnicity	Non-Hispanic Whites	67.23 (0.007)	44.95 (0.325) ***	70.67 (0.007)	64.66 (0.008)
	Non-Hispanic Blacks	11.49 (0.005)	48.72 (0.472)	13.09 (0.005)	10.29 (0.004)
	Hispanic	14.21 (0.006)	31.43 (0.472)	10.41 (0.005)	17.04 (0.007)
	Other races [a]	7.08 (0.004)	35.27 (0.810)	5.84 (0.004)	8.00 (0.004)
Census Region	Northeast	18.41 (0.005)	42.88 (0.612) ***	18.46 (0.005)	18.37 (0.005)
	Midwest	21.70 (0.005)	43.56 (0.550)	22.10 (0.005)	21.40 (0.005)
	South	36.74 (0.006)	44.69 (0.505)	38.39 (0.007)	35.51 (0.007)
	West	23.15 (0.005)	38.88 (0.596)	21.04 (0.006)	24.72 (0.006)
Education	Less than high school	16.10 (0.003)	44.99 (0.511) ***	16.94 (0.003)	15.48 (0.003)
	High school/GED	27.03 (0.003)	45.38 (0.435)	28.68 (0.003)	25.80 (0.003)
	≥ 1 year of college	50.77 (0.004)	40.45 (0.304)	48.02 (0.004)	52.82 (0.004)
Health Insurance	Any Private	68.50 (0.004)	41.11 (0.302) ***	65.84 (0.005)	70.48 (0.005)
	Only Public [b]	16.80 (0.003)	63.00 (0.436)	24.75 (0.004)	10.86 (0.002)
	Uninsured	14.70 (0.003)	27.36 (0.432)	9.40 (0.002)	18.66 (0.004)
Income Categories [c]	Poor (< 100% of FPL)	11.89 (0.002)	45.03 (0.507) ***	12.52 (0.002)	11.42 (0.002)
Near Poor/ Low income (100- 200% of FPL)		17.67 (0.002)	46.10 (0.486)	19.04 (0.003)	16.64 (0.002)
Middle income (200-400% of FPL)		30.26 (0.002)	41.71 (0.375)	29.51 (0.003)	30.82 (0.003)

High income (≥ 400% of FPL)	40.18 (0.005)	41.43 (0.323)	38.93 (0.005)	41.12 (0.005)
Marital status Married	53.49 (0.004)	44.28 (0.350) ***	55.39 (0.005)	52.08 (0.004)
Widowed	6.34 (0.001)	77.93 (0.570)	11.55 (0.002)	2.44 (0.001)
Divorced / Separated	13.60 (0.002)	55.23 (0.530)	16.61 (0.003)	11.35 (0.002)
Never Married	26.57 (0.003)	26.48 (0.358)	16.45 (0.003)	34.13 (0.003)
Employment status Employed	67.23 (0.003)	34.60 (0.282) ***	54.38 (0.004)	76.83 (0.003)
Not employed	32.77 (0.003)	59.53 (0.371)	45.62 (0.004)	23.17 (0.003)
Mean Age	46.45 (0.146)	55.52 (0.178)	55.52 (0.178)	39.68 (0.121)

[a] Other races including American Indian /Alaska Native, Asian, Native Hawaiian/Pacific Islander, and multiple races reported. [b] Public insurance in the MEPS indicates individuals with Medicaid or Medicare who do not have private supplemental plans (Medigap).[c] Family income as a percent of the federal poverty line (FPL)
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

In summary, there is significant variation in the frequency distribution of the major characteristics of the study population. This suggests that these characteristics will be useful in describing my main variable of interest, which is, having a usual source of care that provides office hours in the evenings and weekends. In addition, the distribution of these characteristics is comparable in the population of adults with and without chronic conditions except for age categories. They also differ in marital status and employment status, both of which can be linked to age differences.

Access to extended office hours by population characteristics. Table 4. 2 presents access to extended office hours by selected population characteristics for adults with and without chronic ACSCs. Approximately 1 in 4 adults with chronic ACSCs (26.41 %) had a usual source of care that provided office hours in the evenings and weekends. Adults without chronic conditions had similar (24.94%) prevalence of having a USC with extended office hours. However, though the difference in having a USC with extended office hours for both groups was small in magnitude (24.94% vs. 26.41 %), it was statistically significant with a p-value of zero.

There were statistically significant differences in access to extended office hours by all population characteristics examined, all having p values of zero. A higher proportion of the younger and middle age groups, and nonelderly adults (age < 65 years) had USC that provided

extended office hours. Similarly, adults with some college education, in the high-income category, who were employed, who had private insurance, who were married, were living in the northeast census region, and were females, had the highest percentage of having a USC with extended office hours. Other races including American Indian /Alaska Native, Asian, Native Hawaiian/Pacific Islander, and those who reported multiple races had the highest percentage with a USC that provided extended office hours while non-Hispanic Whites had the lowest.

Table 4.2: Having a USC Providing Extended office hours by Population Characteristics

	All adults (N = 233,795)		Adults with ACSC (N= 98,041)		Adults without ACSCs (N= 135,754)	
Population Characteristics	Percent with a USC that provides office hours in the evenings and weekends	P value	Percent with a USC that provides office hours in the evenings and weekends	P value	Percent with a USC that provides office hours in the evenings and weekends	P value
Total	25.57		26.41	0.000	24.94	0.000
Age Categories		0.000		0.000		0.000
18-25 years	26.09		27.32		25.84	
26-35 years	22.59		25.03		21.91	
36-45 years	27.33		29.59		26.28	
46-55 years	28.17		29.34		27.18	
56-65 years	26.50		26.82		25.98	
66-75 years	24.23		24.85		22.29	
76-85 years	20.39		20.89		17.95	
Elderly Adult		0.000		0.000		0.000
Yes	22.71		23.24		20.76	
No	26.18		27.91		25.23	
Sex		0.000		0.000		0.000
Male	24.01		25.70		22.77	
Female	27.03		27.06		27.00	
Race/ethnicity		0.000		0.000		0.000
Non-Hispanic Whites	26.51		26.35		26.64	
Non-Hispanic Blacks	23.92		25.30		22.61	
Hispanic	21.29		25.90		19.19	
Other races [a]	27.92		30.59		26.46	
Census Region		0.000		0.000		0.000
Northeast	33.25		33.22		33.27	
Midwest	29.89		29.95		29.85	
South	18.72		19.98		17.7	
West	26.28		28.45		24.90	

Education		0.000		0.000		0.000
Less than high school	23.19		24.16		22.40	
High school/GED	24.99		25.72		24.38	
College or higher	26.91		27.86		26.26	
Income Categories [b]		0.000		0.000		0.000
Poor (< 100% of FPL)	19.94		21.86		18.36	
Near Poor/ Low income (100-200% of FPL)	20.94		22.86		19.30	
Middle income (200-400% of FPL)	25.66		27.00		24.70	
High income (≥ 400% of FPL)	29.21		29.17		29.23	
Health Insurance		0.000		0.000		0.000
Any Private Insurance	28.39		28.37		28.40	
Only Public Insurance [b]	23.59		23.61		23.55	
Uninsured	14.69		20.07		12.67	
Marital status		0.000		0.000		0.000
Married	27.45		27.96		27.04	
Widowed	22.13		22.49		20.85	
Divorced / Separated	23.09		24.54		21.50	
Never Married	23.87		25.83		23.17	
Employment status		0.000		0.000		0.000
Employed	26.42		28.43		25.36	
Not employed	23.82		24.00		23.55	

[a] Other races including American Indian /Alaska Native, Asian, Native Hawaiian/Pacific Islander, and multiple races reported. [b] Public insurance in the MEPS indicates individuals with Medicaid or Medicare who do not have private supplemental plans (Medigap).

In summary, all population characteristics examined had statistically significant associations with having a USC providing extended office hours. These associations appear consistent for both populations of adults with and without chronic conditions. The main aim of my first research question is to examine the trends in having a USC providing extended office hours in the population of US adults. My analysis so far has described the study population for my first question and examined how having a USC providing extended office hours differed by categories of population characteristics. The findings from this analysis suggest that in addition to describing the overall trends in having a USC providing extended office hours, it might be interesting to examine the trends in having a USC with extended office hours by categories of the population characteristics. In addition, these findings suggest that these population characteristics are important covariates that need to be considered when examining the association between

having a USC with extended office hours and my outcome variables in question 2 of the dissertation.

Trends in having a usual source of care (USC) and provision of extended office hours by the USC. Three in four (75.21%) adult MEPS participants between 2005 and 2014 had a usual source of care and 1 in 4 (25.57%) had a USC who provided office hours in the evenings and on weekends. Compared to adults without chronic conditions, adults with chronic conditions had a higher prevalence of having a USC (86.51% vs. 66.77%) and having a USC with extended office hours (26.41% vs 24.94%). These differences were statistically significant with p values < 0.000. However, the difference in having a USC with extended office hours is small in magnitude. This suggests that individuals with chronic conditions may be more concerned with having a usual source of care and may not care as much if their provider offers hours in the evenings and weekends. This dissertation aims to provide evidence regarding the importance of having a USC with extended office hours, hence it may provide relevant information for patients in determining what is important in their choice of a USC.

Overall trends in having a USC. Figure 4.1 presents a line chart showing the percentage of those who have a USC for 2005 to 2014 for all adults, adults with chronic ACSCs, and adults without chronic ACSCs. All three groups have similar trends showing an overall decline from 2005 to 2014. Chi-square tests of differences in percent of adults with a USC by year were statistically significant with a p-value < 0.000 for adults with chronic ACSCs, a p-value of 0.0025 for adults without chronic conditions and a p-value of 0.0007 for all adults. For the population of adults with chronic ACSCs, the proportion of individuals with a USC declined from 2006 to 2008, remained stable from 2008 to 2010, increased noticeably from 2010 to 2011, further declined from 2011 to 2012, remained stable from 2012 to 2013, then increased slightly

from 2013 to 2014. For the population of adults without chronic conditions, the initial decline was from 2006 to 2009, the increase from 2009 to 2010, then a further decline from 2010 to 2011 after which it remained stable from 2011 to 2013, then increased slightly from 2013 to 2014.

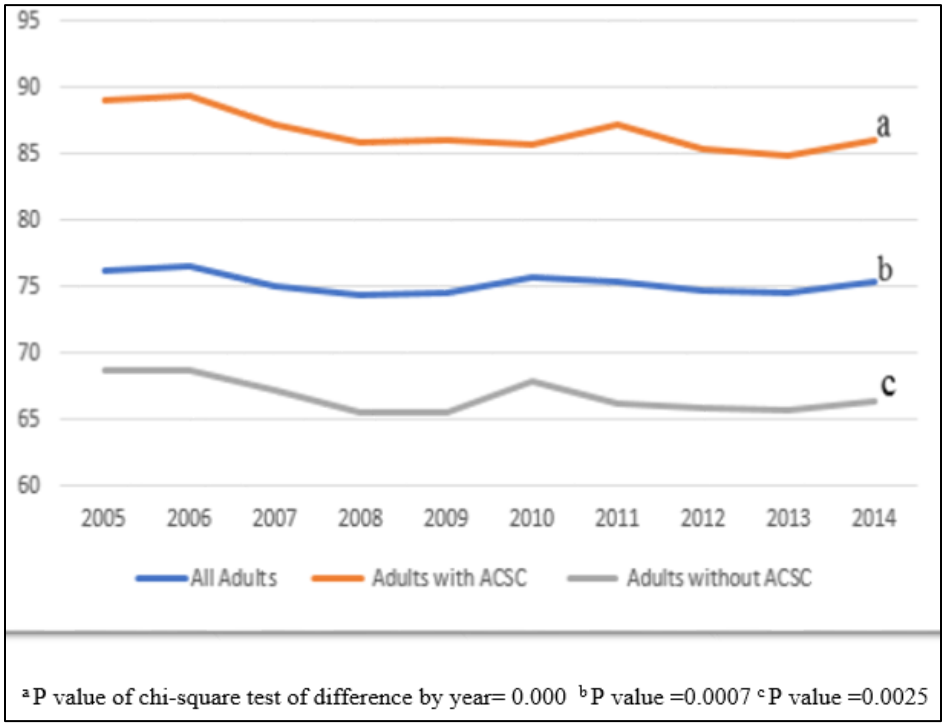

Figure 4.1: Trends in having a usual source of care, 2005 to 2014

Overall trends in having a USC with extended office hours. Figure 4.2 presents trends in having a USC providing extended office hours from 2005 to 2014 for adults with chronic conditions, those without chronic conditions, and all adults. In all three population groups presented in figure 4.2, the percentage of having a USC with extended office hours was less in 2014 than it was in 2005. Chi-square tests of differences in percent of adults with a USC providing extended office hours by year were statistically significant with a p-value of zero for adults with chronic ACSCs and a p-value of 0.009 for adults without chronic conditions.

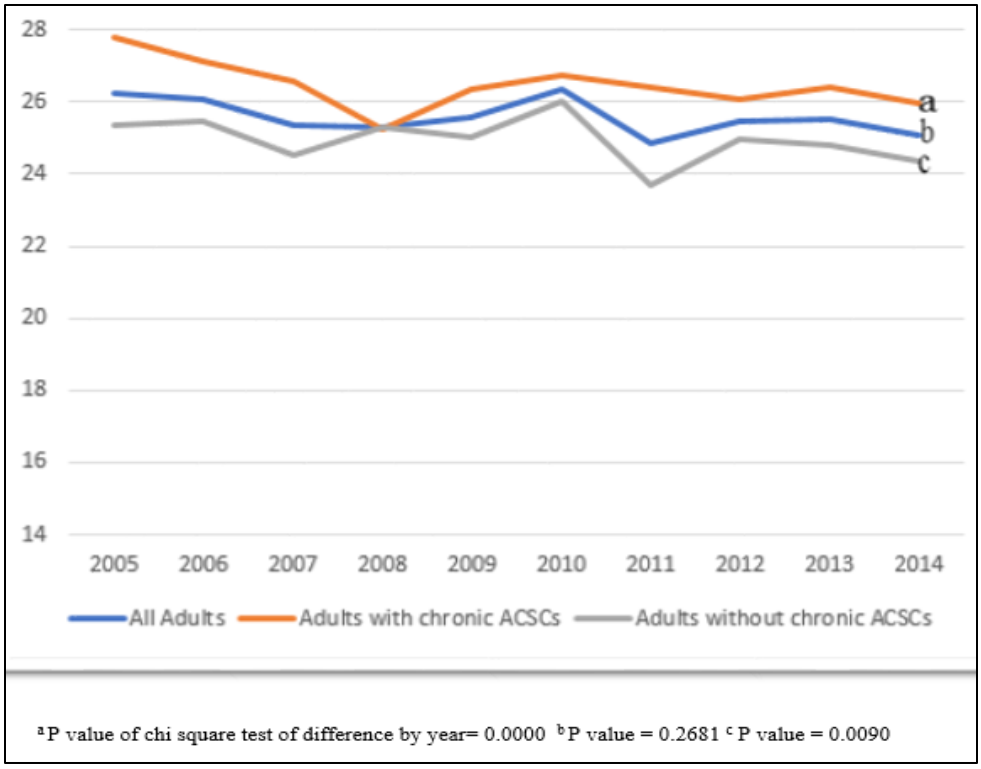

Figure 4.2: Trends in the provision of extended office hours at the USC, 2005 to 2014

Trends in extended office hours across US census region. Figure 4.3 presents trends in having a USC providing office hours in the evenings and weekends by US census regions. The trends for the census regions mirror the overall trends in showing an overall decline from 2005 to 2014 except for the South which has a higher percentage in 2014 than in 2005. In addition, the percentage of having a USC providing extended office hours is notably lower in the South than other regions. The Northeast census region also had the highest percentage in all the years, except in 2012, where it had the same as the Midwest. Chi-square tests of differences by year within each census region were not statistically significant for the Midwest (p-value =0.48), the South (p-value = 0.06), and the West (p-value =0.20). It was statistically significant in the Northeast with a p-value of 0.01.

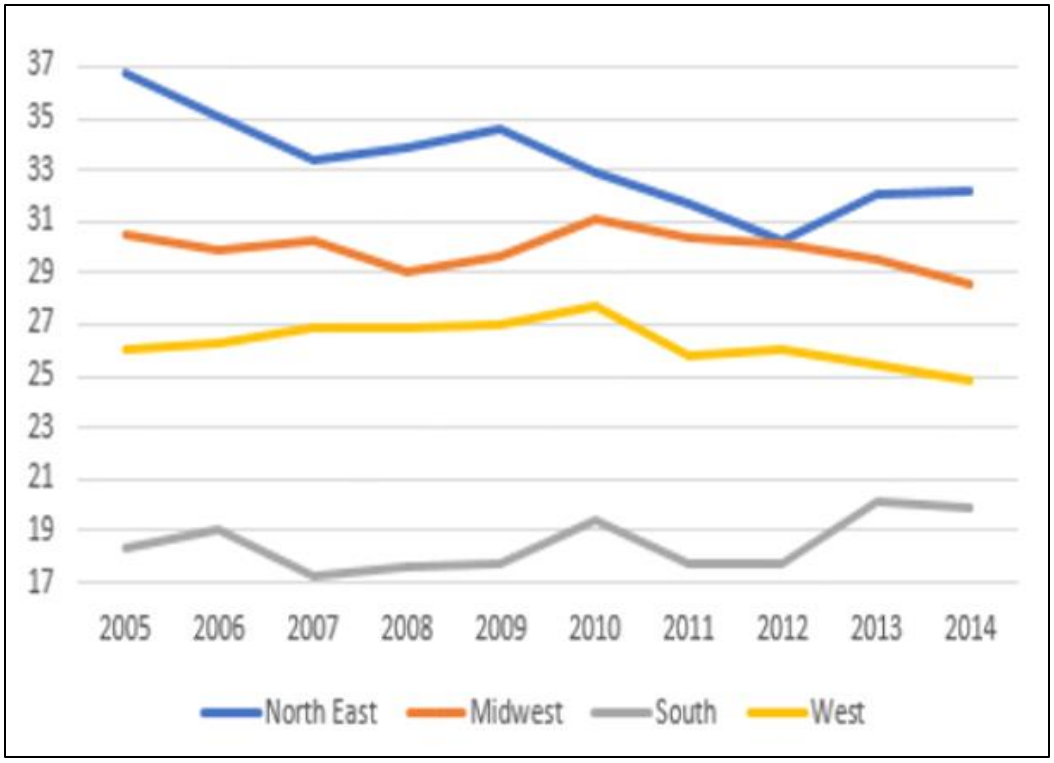

Figure 4.3: Trends in the provision of extended office hours at the USC by census region

Trends in extended office hours across insurance categories. Figure 4.4 presents trends in having a USC providing office hours in the evenings and weekends by health insurance status. Adults with any private insurance consistently had the highest percentage of having a USC providing office hours in the evenings and weekends from 2005 to 2014, followed by those with only public insurance (Medicaid or Medicare without supplemental private plans), then the uninsured.

The proportion of US adults with extended office hours show an overall decline from 2005 to 2014 for all health insurance categories. For those with private insurance, it remained stable from 2005 to 2006, decreased slightly from 2006 to 2007, remained stable again till 2009, after which it increased slightly from 2009 to 2010, then decreased from 2010 to 2011, increased from 2011 to 2012, remained stable from 2012 to 2013, then decreased from 2013 to 2014. The

trends for uninsured adults mirror that of the privately insured in showing an increase from 2008 to 2010, and declines from 2010 to 2011, and 2013 to 2014. On the other hand, the trends for adults with only publicly insurance appears relatively stable.

Chi-square tests of differences by year within each health insurance category were not statistically significant with p values of 0.411, 0.200, and 0.672 for adults with any private insurance, those with only public insurance (Medicaid or Medicare without supplemental private plans), and the uninsured respectively.

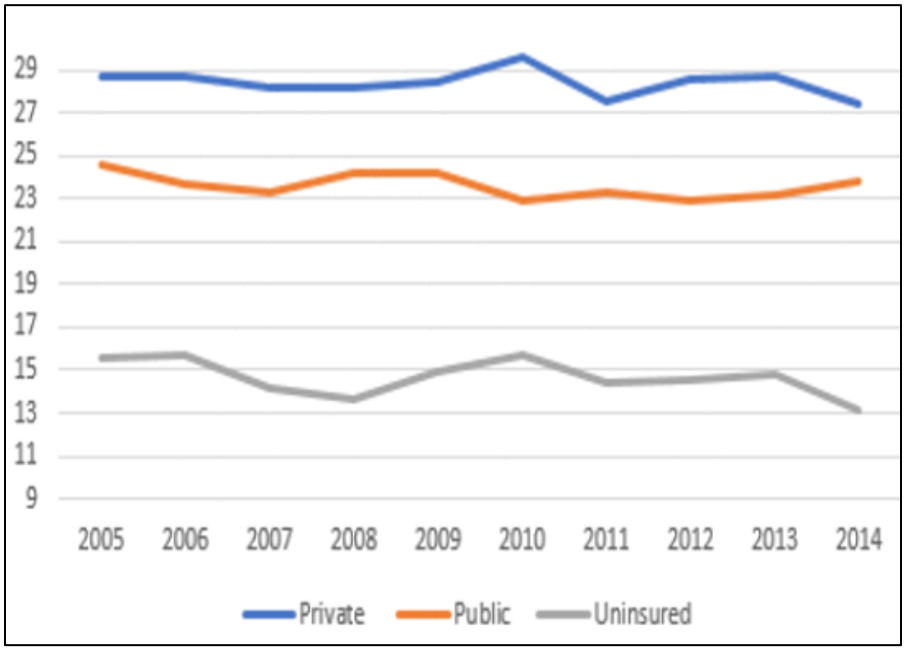

Figure 4.4: Trends in the provision of extended office hours at the USC by insurance status

Trends in extended office hours for elderly and non-elderly adults. Figure 4.5 presents trends in having a USC providing office hours in the evenings and weekends for elderly and non-elderly adults. There was an overall increase in having a USC providing extended office hours from 2005 to 2014 among elderly adults aged 65 years or more while non-elderly adults had an overall decrease in having extended office hours from 2005 to 2014. Chi-square tests of

differences by year for elderly adults and non-elderly adults were not statistically significant with p values of 0.474 and 0.131 respectively.

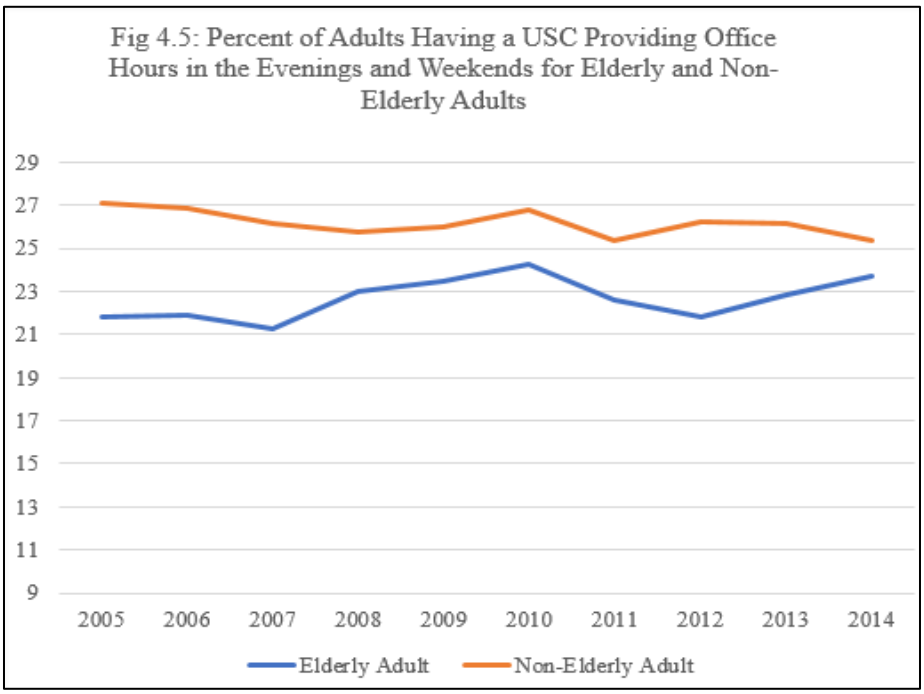

Figure 4.5: Trends in the provision of extended office hours at the USC for elderly and non-elderly adults.

Question 2a: Association between the Provision of Extended Office Hours at the Usual Source of Care and Health Care Utilization and Expenditures among US Adults with Chronic ACSCs

Study population and analytic sample. The study population for this analysis is US adults, aged 18-85 years who reported having a usual source of care and have a diagnosis of at least one of angina, heart failure, asthma, COPD, diabetes, or high blood pressure. Sensitivity analyses in which the study population was limited to adults 35-85 years were conducted and yielded similar results. The analytic sample consists of 21,501 adult MEPS participants between 2007 and 2013 with non-missing values in the independent variable, dependent variables, and

covariates. Information from each participant was gathered over a period of 2 years, therefore data were organized in panels, with the first panel in my analysis being 2007-2008 and the last panel being 2012-2013. The dependent variables in this analysis were from the second year of each panel, while the independent variable and the covariates were obtained from the first year of each panel. There were 68,276 adult participants in the MEPS between 2007- 2013, out of which 38,868 had at least one chronic ACSCs. Out of all adult participants with chronic ACSCs, 24,440 reported having a usual source of care. A total of 2,530 adult participants had responded "don't know" or "inapplicable" to whether their usual source of care offered extended office hours, and hence was dropped from the analysis. Another 409 had missing values in other variables leaving 21,501 observations in the final analytic sample. Sensitivity analysis in which those who responded, "don't know" to the question on extended hours were not dropped from the analysis but included as a separate category was also conducted and yielded similar results.

Description of variables. The dependent variables of this analysis are utilization and expenditure variables, including emergency room utilization, hospital admissions, outpatient or office-based visits to the primary care physician, and total annual healthcare expenditures. The utilization variables were modelled as binary variables (at least one ER visit, at least one inpatient admission, and more than one PCP visit) and as count variables (number of ER visits, number of inpatient admissions, and number of primary care visits). Total annual health care expenditures, adjusted to 2013 dollars, was modelled as a continuous variable.

The independent variable is the provision of office hours in the evenings and weekends by the usual source of care (extended office hours). The responses to this variable in the MEPS data included "yes", "no", "don't know", "not ascertained", "refused", and "inapplicable". In the current analysis, only yes and no were considered valid responses. Approximately 1 in 3

(34.16%) of individuals in the final analytic sample reported that their usual source of care offered office hours in the evenings and weekends. Several covariates including age, sex, insurance status, level of education, self-reported health status, type of chronic disease, race, marital status, smoking status, US census region where the participant lives, and year of the data were included in the regression models of healthcare utilization and expenditures. These covariates were chosen based on the conceptual model discussed in chapter 2 of this dissertation. The specifications of these variables are described in the variable specification section of chapter 3.

Descriptive analysis of regression variables. Table 4.3 displays the descriptive statistics of the dependent variables and covariates for the study sample, and by the provision of extended office hours. Column 1 presents the percent distribution or means of variables for the study sample. Columns 2, 3, and 4 present the descriptive statistics of the variables by the provision of extended office hours. All statistics were computed using the survey weights and accounted for clustering and stratification in the data.

Dependent variables. As shown in column 1 of table 4.3, about 1 in 5 (18.68%) of the study participants visited the ER at least once in the second year of the study while about 1 in 7 (13.56%) had at least 1 hospital admission in the second year. As expected, visits to the primary care physician were the most prevalent, with approximately 3 in 4 adults (73.88%) visiting the PCP at least once and 1 in 2 adults (52.06%) more than once in the second year of study. The average number of PCP visits were also higher than the number of ER visits or hospital admissions, with the mean visits for those with at least 1 visit in each category being 3.27, 1.48, and 1.39 for PCP visits, ER visits, and hospital admissions respectively. Total annual health expenditures ranged between 0 and 573,072 in 2013 US dollars (USD), however, only 3.8% of

the study sample had zero expenditures. Mean and median expenditures in 2013 USD were 8829.95 (SD = 16,812.76) and 3514.33(IQR = 8063.59) respectively.

Covariates. The frequency distribution of the covariates is shown in column 1 of table 4.3. About half (54.40%) of the study sample were females; 2 in 3 adults (67.37) had any private insurance, 25.52% had only public insurance (Medicaid or Medicare without supplemental private plans), while 7.11% were uninsured. High blood pressure (73.69%) was the most prevalent chronic condition while COPD was the least prevalent (10.96%). Age of study participants ranged from 0 to 85 years, with most being 36-55 years (33.37%), and the least prevalent age group being 18-35years (12.17%).

Table 4.3: Descriptive statistics of regression variables

Variables	Percent Distribution of Study Sample N= 21,501	Percent with USC offering extended office hours	Percent Distribution of those with USC offering extended office hours N= 7,377	Percent Distribution of those without USC offering extended office hours N= 14,124
Total	100	34.16	100	100
Dependent Variables				
At least 1 ER visit, %	18.68	31.30	17.11	19.49***
At least 1 inpatient visit, %	13.56	32.11	12.74	13.98
At least 1 PCP visit, %	73.88	32.98	71.32	75.21***
More than 1 PCP visit, N (%)	52.06	31.67	48.26	54.03***
Mean ER visits (S.E)	0.28 (0.007)	0.25 (0.009)	0.25 (0.009)	0.29 (0.008) ***
Mean ER visits given at least 1 ER visit (S.E)	1.48 (0.020)	1.47 (0.035)	1.47 (0.035)	1.49 (0.024)
Mean inpatient visits (S.E)	0.19 (0.005)	0.17 (0.007)	0.17 (0.007)	0.20 (0.007) ***
Mean inpatient visits given at least 1 inpatient visit (S.E)	1.39 (0.020)	1.30 (0.027)	1.30 (0.027)	1.43 (0.023) ***
Mean PCP visits (S.E)	2.42 (0.035)	2.26 (0.050)	2.26 (0.050)	2.50 (0.045) ***
Mean PCP visits given at least 1 PCP visit (S.E)	3.27 (0.043)	3.16 (0.060)	3.16 (0.060)	3.33 (0.054) *
Mean total annual healthcare expenditures (S.E) [b]	8829.95 (158.76)	7947 (214.63)	7947 (214.63)	9288.07 (208.22) ***
Median total annual healthcare expenditures (S.E) [b]	3514.33 (64.51)	2946.24 (96.07)	2946.24 (96.07)	3822 (89.51) ***

Covariates, %				
Age Categories				
18- 35years	12.17	43.29	15.43	10.48***
36-55years	33.37	38.16	37.28	31.34
56-64years	21.11	32.56	20.12	21.62
65-75years	19.15	29.66	16.63	20.46
76-85years	14.20	25.38	10.55	16.10
Female sex	54.40	34.05	54.23	54.49
Non-Hispanic Blacks	12.23	34.55	12.37	12.16
Education				
Less than high school	16.77	30.88	15.13	17.62***
Completed high school/GED	30.94	32.72	29.64	31.61
One or more years in college	52.29	36.08	55.23	50.77
Insurance Status				
Any Private Insurance	67.37	36.23	71.46	65.25***
Only Public Insurance	25.52	28.14	21.02	27.85
Uninsured	7.11	36.11	7.52	6.90
Current smoking status	16.68	33.97	16.59	16.73
Asthma	20.68	38.63	16.81	12.18***
Diabetes	22.20	31.15	20.24	23.22***
Heart Disease (Angina/CHD/Other heart Disease)	30.09	30.58	26.93	31.73***
COPD	10.96	29.66	9.52	11.71***
High Blood Pressure	73.69	32.77	70.68	75.25***
Perceived health rated as poor	6.12	28.56	5.11	6.64***
Census Region				
Northeast	18.89	42.12	23.29	16.60***
Midwest	22.25	38.45	25.04	20.80
South	37.80	26.19	28.98	42.38
West	21.06	36.80	22.69	20.22

Notes: Statistics were computed using weights and accounting for clustering and stratification in data. ER is Emergency Room. PCP is Primary Care Provider.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

In summary, the frequency distribution of binary measures of healthcare utilization shows adequate variation that can be explored using a logistic regression model. The expenditure variable is largely skewed to the right with the mean about 2.5 times the median. The median is a better measure of central tendency for highly skewed data as it is usually resistant to the effects of outliers. Log-transformation of highly skewed data also helps reduce the skewness of highly skewed data, hence in addition to an ordinary least square (OLS) regression model of the untransformed expenditure variable, a median regression which regresses to the median, as well as an OLS regression model of the log-transformed expenditure was estimated.

Bivariate analysis of dependent variables and covariates by extended office hours. Columns 2, 3, and 4 of table 4.3 above present the descriptive statistics of the regression variables by the provision of extended office hours at the USC.

Dependent variables. Binary measures of ER visits and PCP visits were significantly lower with the provision of extended office hours. The percent of those with at least 1 inpatient visit was also lower with the provision of extended office hours, but not statistically significant at the 5% level (see columns 2, 3, & 4 of table 4.3). In addition, the mean number of the utilization variables also show a statistically significant reduction for those whose USC provided extended office hours, except for the mean number of ER visits among those with at least 1 visit which showed no difference by the provision of extended office hours. Mean and median total annual healthcare expenditures were also significantly lower with the provision of extended office hours. These statistics provide suggestive evidence that the availability of extended office hours at the USC affects healthcare utilization and expenditures.

Covariates. Most of the covariates (except female, non-Hispanic Black, and current smoking status) had statistically significant associations with the provision of extended office hours (see columns 2, 3, and 4 of table 4.3). These three covariates were also indicated in the conceptual framework to be conceptually related to healthcare utilization and expenditures but not related to the provision of extended hours. The finding of no statistically significant association between these three covariates and extended hours confirms the information in the conceptual framework.

Study participants aged 18-55years, with one or more years of college, private insurance, with a diagnosis of asthma, or who were living in the Northeast were more likely to have a USC offer extended office hours. On the other hand, older participants, those with less than high

school education or who only completed high school, those with only public insurance (Medicaid or Medicare without supplemental private plans), with a diagnosis of diabetes, heart disease, COPD, or high blood pressure, those who rated their perceived health status as poor, and those who lived in the South were less likely to have a USC providing extended office hours.

In summary, study participants whose USC provided extended office hours had less healthcare utilization and expenditures. Most covariates also show significant association with extended office hours. As indicated in the conceptual model, these variables are also potential determinants of healthcare utilization and expenditures. Therefore, if not included in the regression models as covariates, these variables may confound the observed unadjusted relationship between the provision of extended office hours at the USC and healthcare utilization and expenditures.

Regression models. Tables 4.4, 4.5, 4.6, & 4.7 present the regression models of healthcare utilization and expenditures as a function of extended office hours conditioned on covariates. Each of tables 4.4, 4.5, & 4.6 presents four models. Models 1, 2, and 3 are binary logistic models. Model 1 is the unadjusted bivariate model while model 2 includes the minimum covariates (age, health insurance, poor self-rated health status, type of chronic condition, education, & census region) necessary to obtain an unbiased estimate of the relationship between the dependent variable and extended office hours. These covariates were indicated in the conceptual frameworks to be related to both healthcare utilization and extended hours; failure to control for them will likely result in a biased estimate of the association between extended hours and healthcare utilization and expenditure. Model 3 includes covariates related to healthcare utilization and expenditures but not related to extended hours to improve the overall fit of the model. The fourth model is a hurdle Poisson model which first estimates the log odds of having

one or more ER visits, then subsequently estimates the log of the expected number of ER visits for those with at least one visit. The first stage of the hurdle Poisson model is identical to the full binary logistic model (model 3), therefore only the second stage is presented in table 4.4. The estimates are presented as odds ratios (OR) for the binary models and incidence rate ratios (IRR) for the Poisson models.

ER utilization. Without adjusting for the effect of other factors, adults with chronic ACSCs who have a USC providing extended office hours had 15% less odds of having one or more ER visit (OR= 0.85, 95% CI [0.78,0.93], p = 0.001) than those who do not have extended office hours (see column 1, table 4.4). After adjusting for covariates in the most parsimonious model (model 2), those with USC providing extended office hours still had 10% lower odds of having one or more ER visit than those without (OR=0.90, 95% CI [0.82,0.99], p=0.026). The odds ratio obtained for extended office hours in the full model was 0.899, almost identical to the odds ratio in the most parsimonious model suggesting that the additional covariates in Model 3 were indeed not necessary to obtain an unbiased estimate on the relationship between extended office hours and ER utilization. However, Model 3 had a higher Pseudo R squared, and lower information criteria (AIC and BIC) compared to Model 2 suggesting that Model 3 is a better model than Model 2. The hurdle Poisson model showed no relationship between the number of ER visits and provision of extended office hours by the USC (IRR= 0.98, 95%CI [0.86,1.15], p = 0.908).

The results of the logistic and hurdle Poisson regression models provide some evidence that the provision of extended office hours at the USC affects whether adults with chronic ACSCs utilize the emergency room at least once in a year (extensive margin) but has no effect

on the intensity of ER visits (intensive margin) among those who have been to the ER at least once in a year.

Most of the covariates also showed statistically significant associations with ER visits after adjusting for the effect of extended office hours and other covariates (see columns 3 and 4 of table 4.4). Age group, health insurance status, poor perceived health status, heart disease, COPD, high blood pressure, and married, were statistically significant in both the logistic and hurdle Poisson models. Asthma, diabetes, level of education, non-Hispanic Black race, female sex, current smoker, and living in the Southern US census region were statistically significant only in the logistic regression models.

Compared to adults with chronic conditions aged 18-35 years, older adults aged 36-75 years had lower odds of having one or more ER visits and lower rates of visits among those with at least 1 visit (see columns 3 and 4 of table 4.4). However, elderly adults aged 76-85 years had 13% more odds of having one or more ER visit, although this was not statistically significant at the 5% level (OR= 1.13, 95% CI [0.95, 1.34], p= 0.185). In addition, although adults aged 75-85 years had higher odds of having one or more ER visit, they had lower rates of ER visits compared to adults aged 18-35 years (IRR = 0.70, 95% CI [0.55, 0.90], p= 0.005).

Study participants with only public insurance (Medicaid or Medicare without supplemental private plans), poor perceived health status, and a diagnosis of heart disease, COPD, or high blood pressure, had significantly higher odds of having one or more ER visit and higher rates of visits, given one or more ER visit (see columns 3 and 4 of table 4.4). Those with no college education, a diagnosis of asthma or diabetes, who were non-Hispanic Blacks, who were females, and currently smoke cigarettes had significantly higher odds of having one or more ER visit but showed no significant association in the hurdle Poisson model. Married study

participants had significantly lower odds of having one or more ER visit and lower rates of ER visits given one or more visit. Similarly, those living in the Southern US census region had significantly lower odds of having one or more ER visit.

The effect of having a USC providing extended office hours was further examined across type of chronic conditions. The results are presented in table 4.5 below. The point estimates of the odds ratios for extended office hours obtained for adults with high blood pressure (0.88), asthma (0.90), and diabetes (0.93) were similar to the odds ratio of 0.90 obtained for the population of adults with chronic conditions (see table 4.4 and 4.5 below). However, due to small sample sizes, these estimates were not as precise and only statistically significant for the population of adults with a diagnosis of high blood pressure.

In summary, having a USC who provides office hours in the evenings and weekends was significantly associated with a reduction in the extensive margin of emergency room utilization but had no effect on its intensive margin. Other factors examined also showed significant association with odds of having one or more ER visit and the number of ER visits among those who had one or more ER visit.

Table 4.4: Regression models of ER utilization

		Binary Logistic			Hurdle Poisson [a]
Variables		Odds Ratios			IRR
		Model 1	Model 2	Model 3	Model 4
Extended office hours		0.853***	0.900*	0.899*	0.980
		[0.780,0.933]	[0.822,0.986]	[0.821,0.985]	[0.846,1.136]
Age groups	*18-35years*		1	1	1
			[1,1]	[1,1]	[1,1]
	36-55years		0.801**	0.798**	0.808
			[0.702,0.915]	[0.698,0.913]	[0.626,1.042]
	56-64years		0.745***	0.764**	0.673**
			[0.634,0.875]	[0.649,0.899]	[0.523,0.865]
	65-75years		0.680***	0.726***	0.593***
			[0.580,0.798]	[0.616,0.856]	[0.463,0.759]
	76-85years		1.023	1.125	0.702**
			[0.864,1.211]	[0.945,1.339]	[0.549,0.898]
Health Insurance	*Any Private*		1	1	1
			[1,1]	[1,1]	[1,1]

Only Public [b]		1.499***	1.422***	1.418***
		[1.348,1.668]	[1.279,1.581]	[1.247,1.612]
Uninsured		1.113	1.073	1.349*
		[0.940,1.316]	[0.910,1.265]	[1.044,1.743]
Perceived health rated poor		1.753***	1.735***	1.354***
		[1.488,2.066]	[1.474,2.042]	[1.141,1.605]
Heart disease		1.406***	1.429***	1.444***
		[1.278,1.548]	[1.296,1.575]	[1.262,1.652]
COPD		1.598***	1.525***	1.497***
		[1.391,1.836]	[1.325,1.756]	[1.299,1.725]
Asthma		1.284***	1.265***	0.950
		[1.159,1.422]	[1.143,1.402]	[0.816,1.105]
Diabetes		1.440***	1.443***	1.147
		[1.316,1.577]	[1.316,1.581]	[0.979,1.343]
Education *≥ 1 year of college*		1	1	1
		[1,1]	[1,1]	[1,1]
Completed high school/GED		1.187**	1.161**	1.149
		[1.063,1.324]	[1.040,1.295]	[0.971,1.360]
Less than high school		1.252***	1.213**	1.084
		[1.117,1.403]	[1.080,1.362]	[0.896,1.311]
Census Regions *Northeast*		1	1	1
		[1,1]	[1,1]	[1,1]
Midwest		1.024	1.024	1.058
		[0.883,1.186]	[0.883,1.187]	[0.817,1.369]
South		0.878	0.856*	1.095
		[0.761,1.013]	[0.741,0.990]	[0.862,1.390]
West		0.887	0.919	1.148
		[0.762,1.033]	[0.788,1.071]	[0.870,1.515]
Non-Hispanic Blacks			1.350***	0.961
			[1.220,1.493]	[0.821,1.125]
Female			1.164***	1.170
			[1.065,1.272]	[0.999,1.369]
Current Smoker			1.349***	1.089
			[1.213,1.502]	[0.932,1.271]
Constant	0.245***	0.176***	0.148***	0.538***
	[0.218,0.275]	[0.143,0.217]	[0.118,0.185]	[0.373,0.776]
Pseudo R squared [c]	0.002	0.041	0.045	
Akaike Information Criteria [c] (AIC)	4.41e+08	4.24e+08	4.22e+08	
Bayesian Information Criteria[c] (BIC)	4.41e+08	4.24e+08	4.22e+08	
Sample size	21,501	21,501	21,501	21,501

Note. Confidence intervals in parentheses. All models include year fixed effects and accounted for survey design of the data. Sensitivity analyses restricting study population to adults 35 years and above yielded similar results. In addition, including those who responded don't know to the extended hours variable in the regression models also yielded similar results. Robustness tests using age as a continuous variable and including a squared term also yielded similar results.

a- Second stage of a Hurdle Poisson model which specifies the number of ER visits for observations with non-zero ER visits. IRR is Incidence Rate Ratios. b- Public insurance in the MEPS indicates individuals with Medicaid or Medicare who do not have private supplemental plans (Medigap). c-Pseudo R squared, AIC, & BIC obtained by running models using weights but without accounting for the survey design of the data because the later does not produce Pseudo R squared. However, no value was obtained for the hurdle Poisson model.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 4.5: Binary logistic regression models of ER utilization by type of chronic condition

	Odds Ratios [95% CI]				
	HBP	COPD	Asthma	Heart Disease	Diabetes
Extended office hours	0.878*	1.013	0.894	0.951	0.925
	[0.785,0.982]	[0.811,1.265]	[0.725,1.103]	[0.807,1.122]	[0.761,1.124]
Age groups *18-35years*	1	1	1	1	1
	[1,1]	[1,1]	[1,1]	[1,1]	[1,1]
36-55years	0.796*	0.742	0.772*	0.836	0.702
	[0.647,0.979]	[0.491,1.122]	[0.613,0.972]	[0.616,1.136]	[0.482,1.021]
56-64years	0.720**	0.620	0.771	0.835	0.645*
	[0.575,0.903]	[0.383,1.004]	[0.552,1.076]	[0.607,1.148]	[0.441,0.942]
65-75years	0.704**	0.501**	0.789	0.736	0.635*
	[0.558,0.889]	[0.321,0.782]	[0.543,1.148]	[0.533,1.016]	[0.422,0.954]
76-85years	1.091	0.782	1.099	1.167	0.889
	[0.852,1.397]	[0.487,1.257]	[0.693,1.744]	[0.859,1.587]	[0.591,1.338]
Health Insurance *Any Private*	1	1	1	1	1
	[1,1]	[1,1]	[1,1]	[1,1]	[1,1]
Only Public [a]	1.367***	1.252	1.592***	1.345***	1.274**
	[1.214,1.540]	[0.930,1.684]	[1.258,2.015]	[1.136,1.592]	[1.075,1.510]
Uninsured	1.080	0.634	1.014	1.206	1.043
	[0.890,1.309]	[0.363,1.107]	[0.705,1.457]	[0.876,1.661]	[0.742,1.467]
Perceived health rated poor	1.706***	1.524**	1.492**	1.656***	1.469**
	[1.436,2.027]	[1.170,1.984]	[1.108,2.010]	[1.322,2.074]	[1.132,1.908]
Heart disease	1.443***	1.202	1.372**		1.597***
	[1.290,1.614]	[0.936,1.544]	[1.087,1.732]		[1.303,1.958]
COPD	1.582***		1.325*	1.340*	1.682***
	[1.344,1.862]		[1.041,1.686]	[1.058,1.696]	[1.278,2.215]
Asthma	1.286***	1.093		1.276*	1.199
	[1.129,1.464]	[0.837,1.428]		[1.030,1.580]	[0.957,1.502]
Diabetes	1.417***	1.661***	1.349*	1.540***	
	[1.270,1.582]	[1.264,2.182]	[1.057,1.720]	[1.296,1.830]	
High Blood Pressure		1.331*	1.160	1.142	1.087
		[1.031,1.718]	[0.932,1.444]	[0.968,1.347]	[0.875,1.352]
Education *≥ 1 year of college*	1	1	1	1	1
	[1,1]	[1,1]	[1,1]	[1,1]	[1,1]
Completed high school/GED	1.092	1.397*	1.195	1.174	1.074
	[0.961,1.241]	[1.023,1.907]	[0.952,1.500]	[0.994,1.388]	[0.885,1.303]
Less than high school	1.168*	1.652**	1.165	1.170	1.088
	[1.026,1.331]	[1.176,2.321]	[0.903,1.502]	[0.975,1.404]	[0.882,1.342]
Regions *Northeast*	1	1	1	1	1
	[1,1]	[1,1]	[1,1]	[1,1]	[1,1]
Midwest	1.027	0.660*	0.770*	1.122	0.948
	[0.867,1.217]	[0.455,0.958]	[0.600,0.988]	[0.869,1.449]	[0.723,1.242]
South	0.800**	0.519***	0.674**	0.888	0.835
	[0.676,0.946]	[0.368,0.734]	[0.508,0.895]	[0.718,1.100]	[0.670,1.040]
West	0.960	0.710	0.668**	1.062	0.930
	[0.791,1.167]	[0.485,1.042]	[0.504,0.886]	[0.833,1.354]	[0.710,1.217]
Non-Hispanic Blacks	1.280***	1.281	1.511***	1.204	1.157
	[1.131,1.450]	[0.948,1.731]	[1.227,1.861]	[0.996,1.455]	[0.981,1.363]
Female	1.170**	1.163	1.324*	1.144	1.140
	[1.054,1.298]	[0.908,1.490]	[1.060,1.654]	[0.991,1.322]	[0.940,1.383]

Current Smoker	1.338***	1.173	1.497***	1.281**	1.354**
	[1.167,1.535]	[0.920,1.495]	[1.188,1.887]	[1.069,1.535]	[1.090,1.682]
Constant	0.170***	0.344***	0.210***	0.171***	0.274***
	[0.130,0.223]	[0.187,0.634]	[0.140,0.316]	[0.115,0.252]	[0.166,0.452]
Pseudo R squared[b]	0.047	0.058	0.061	0.039	0.039
AIC[b]	3.11e+08	5.76e+07	9.40e+07	1.44e+08	1.07e+08
BIC[b]	3.11e+08	5.76e+07	9.40e+07	1.44e+08	1.07e+08
Sample size	16,154	2281	4470	6041	5428

Note. Confidence intervals in parentheses. All models include year fixed effects and accounted for survey design of the data. a- Public insurance in the MEPS indicates individuals with Medicaid or Medicare who do not have private supplemental plans (Medigap). b - Pseudo R squared, AIC, & BIC obtained by running models using weights but without accounting for the survey design of the data because the later does not produce Pseudo R squared.
HBP- High Blood Pressure. COPD- Chronic Obstructive Pulmonary Disease.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Inpatient utilization. Without adjusting for the effect of other factors, adults with chronic ACSCs who have a USC providing extended office hours had 10% less odds of having having one or more hospital admission (OR= 0.90, 95% CI [0.81,1.00], p = 0.048) compared to those who don't have extended office hours (see column 1, table 4.6). However, this relationship reversed and was no longer statistically significant after adjusting for covariates (OR= 1.03, 95% CI [0.92,1.16], p = 0.576), suggesting that the observed unadjusted association is likely due to factors other than the provision of extended office hours. The estimates from the parsimonious and full models were similar, 1.032, and 1.033 respectively (see columns 3 and 4 of table 4.6).

In contrast with the lack of significant association between extended office hours and the odds of having one or more inpatient visit, the hurdle Poisson model of inpatient utilization showed a significant association between extended office hours and the number of hospital admissions. Among those with at least 1 inpatient visit, having a USC offering extended office hours was associated with a 21% lower rate of hospital admissions (IRR = 0.79, 95% CI [0.67,0.94], p = 0.008). These results provide some evidence that the provision of extended office hours at the USC significantly reduce the intensive margin of inpatient utilization but has

no effect on its extensive margin. Potential explanations for this finding will be discussed in chapter 5 of this dissertation.

Some of the covariates also showed statistically significant associations with inpatient visits in the logistic and hurdle Poisson models (see columns 3 and 4 of table 4.6). Adults with chronic conditions who had only public insurance (Medicare or Medicaid without private supplemental plans), had a diagnosis of heart disease or high blood pressure or rated their perceived health status as poor, had higher odds of having one or more inpatient visit and higher rates of visits among those with one or more visit.

Study participants who were aged 65 or more had a higher likelihood of at least one inpatient visit, however, there was no significant relationship between this age group and the number of inpatient visits among those with at least one visit. Similarly, those with a diagnosis of COPD, asthma, or diabetes, females and current smokers had higher odds of having one or more inpatient visits but showed no significant relationship with the number of visits.

Individuals on Medicaid or Medicare without private supplemental plans had significantly higher odds of having one or more inpatient visits compared to privately insured individuals. Perhaps surprisingly, uninsured individuals had 33% lower odds of having one or more inpatient visits compared to those with private insurance (OR=0.67, 95% CI [0.53,0.84], p=0.001). This relationship was reversed in the hurdle Poisson model; however, it was not statistically significant (IRR = 1.20, 95% CI [0.83,1.74], p=0.324). In the models of ER visits, being uninsured showed no significant relationship with the odds of having one or more ER visit but was significantly associated with higher rates of ER visits among those with at least one ER visit (see columns 3 & 4 of table 4.4).

In contrast with the observed association of education with ER visits, there was no significant relationship between educational status and inpatient visits in both the logistic and the hurdle Poisson models (see columns 3 & 4 of table 4.6).

Table 4.6: Regression models of inpatient utilization

		Binary Logistic			Hurdle Poisson [a]
Variables		Odds Ratios			IRR
		Model 1	Model 2	Model 3	Model 4
Extended office hours		0.897*	1.032	1.033	0.794**
		[0.805,0.999]	[0.920,1.159]	[0.921,1.159]	[0.671,0.941]
Age groups	*18-35years*		1	1	1
			[1,1]	[1,1]	[1,1]
	36-55years		0.896	0.896	1.141
			[0.733,1.097]	[0.733,1.096]	[0.826,1.576]
	56-64years		1.072	1.087	1.295
			[0.860,1.338]	[0.874,1.352]	[0.882,1.902]
	65-75years		1.399**	1.446***	1.268
			[1.138,1.719]	[1.181,1.770]	[0.909,1.768]
	76-85years		2.159***	2.255***	1.176
			[1.723,2.706]	[1.813,2.806]	[0.827,1.673]
Health Insurance	*Any Private*		1	1	1
			[1,1]	[1,1]	[1,1]
	Only Public [b]		1.292***	1.258***	1.267**
			[1.157,1.441]	[1.127,1.405]	[1.079,1.487]
	Uninsured		0.677**	0.665***	1.202
			[0.534,0.859]	[0.525,0.843]	[0.834,1.733]
Perceived health rated poor			2.454***	2.438***	1.368**
			[2.038,2.955]	[2.025,2.935]	[1.081,1.730]
Heart disease			1.472***	1.486***	1.374***
			[1.320,1.641]	[1.333,1.658]	[1.153,1.638]
COPD			1.519***	1.481***	1.157
			[1.300,1.775]	[1.268,1.731]	[0.946,1.415]
Asthma			1.173*	1.154*	1.103
			[1.025,1.342]	[1.008,1.321]	[0.910,1.336]
Diabetes			1.479***	1.483***	1.240*
			[1.337,1.635]	[1.341,1.639]	[1.015,1.513]
Education	*≥ 1 year of college*		1	1	1
			[1,1]	[1,1]	[1,1]
	Completed high school/GED		1.046	1.032	1.060
			[0.935,1.170]	[0.921,1.155]	[0.867,1.294]
	Less than high school		1.089	1.071	1.143
			[0.968,1.225]	[0.950,1.207]	[0.907,1.440]
Census Regions	*Northeast*		1	1	1
			[1,1]	[1,1]	[1,1]
	Midwest		0.993	0.994	1.072
			[0.840,1.173]	[0.840,1.175]	[0.830,1.385]
	South		0.928	0.920	1.133
			[0.799,1.077]	[0.793,1.068]	[0.899,1.429]

West		0.799*	0.812*	0.992
		[0.670,0.952]	[0.681,0.968]	[0.748,1.317]
Non-Hispanic Blacks			1.133	0.872
			[0.996,1.288]	[0.721,1.055]
Female			1.136*	0.946
			[1.007,1.282]	[0.806,1.110]
Current Smoker			1.168*	1.106
			[1.003,1.360]	[0.900,1.359]
Constant	0.177***	0.0931***	0.0830***	0.391***
	[0.156,0.201]	[0.0725,0.120]	[0.0636,0.108]	[0.254,0.601]
Pseudo R squared [c]	0.001	0.061	0.062	
Akaike Information Criteria [c] (AIC)	3.64e+08	3.42e+08	3.41e+08	
Bayesian Information Criteria[c] (BIC)	3.64e+08	3.42e+08	3.41e+08	
Sample size	21,501	21,501	21,501	21,501

Note. Confidence intervals in parentheses. All models include year fixed effects and accounted for survey design of the data. a- Second stage of a Hurdle Poisson model which specifies the number of ER visits for observations with non-zero ER visits. IRR is Incidence Rate Ratios. b- Public insurance in the MEPS indicates individuals with Medicaid or Medicare who do not have private supplemental plans (Medigap). c-Pseudo R squared, AIC, & BIC obtained by running models using weights but without accounting for the survey design of the data because the later does not produce Pseudo R squared. However, no value was obtained for the hurdle Poisson model.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

In summary, the provision of extended office hours at the USC was significantly associated with a reduction in the intensive margin of inpatient utilization but showed no association with the extensive margin of inpatient utilization. Taken together with this study's finding of an association between the provision of extended office hours at the USC and the extensive margin of ER visits, this finding of no reduction in the extensive margin of inpatient utilization suggests that the provision of extended office hours at the USC reduces utilization of high acuity care for conditions that are not severe enough to require hospital admission. The potential explanations for these findings will be discussed in greater details in chapter 5 of this dissertation.

Primary care utilization. Table 4.7 presents binary logistic regression models of the odds of having more than one primary care visit and a hurdle Poisson model of the rates of primary care visit among those with at least one primary care visit. The binary measure of primary care visit was defined as more than one visit rather than having one or more visit because given the

population of adults with chronic conditions, visiting the PCP at least once in a year is expected. Having a provider who offers hours in the evenings and weekends will likely not affect the probability of one visit. It is rather likely to affect the probability of more than one visit. Without adjusting for the effect of other factors, adults with chronic ACSCs who have a USC providing extended office hours had 21% lower odds of having more than one primary care visit in a year (OR= 0.79, 95% CI [0.73,0.87], p = 0.000) compared to those whose usual source of care (USC) does not offer extended office hours (see column 1, table 4.6). In the full model, those with USC providing extended office hours had 9% lower odds of having more than one primary care visit in a year than those without (OR=0.91, 95% CI [0.84,1.00], p=0.045). On the other hand, there was no relationship between the provision of extended office hours by the USC and the intensive margin of primary care visit (IRR= 1.00, 95%CI [0.95,1.05] p= 0.953). These findings suggest that the reduction in the extensive margin of ER visits seen with the provision of extended office hours at the USC is not driven by a corresponding increase in primary care visits as would be expected. Rather, it is likely driven by the timing of the primary care visits. Perhaps, the provision of extended office hours at the USC encourages individuals who would have otherwise not visited their primary care provider at all in a year due to extenuating circumstances such as work schedules, to do so, consequently leading to improved chronic disease outcomes, and reduced need for overall healthcare utilization, including a reduction in emergency room visits as well as primary care visits.

Most of the covariates also showed significant associations with primary care visits after adjusting for the effect of extended office hours and other covariates (see columns 3 and 4 of table 4.7). Age group, public insurance (Medicaid or Medicare without supplemental private plans), poor perceived health status, a diagnosis of heart disease, COPD, asthma, diabetes, or

high blood pressure, non-Hispanic black race, and female sex, were statistically significant in both the logistic and hurdle Poisson models. These covariates were associated with higher odds of having more than one primary care visit and higher rates of visits except for the non-Hispanic black race which was associated with lower odds of having more than one primary care visit and lower rates of visits among those with at least one visit (see columns 3 and 4 of table 4.7).

The effect of age on the odds of more than one primary care visit is especially worthy of note. Compared to adults aged 18-35 years, adults aged 36-55 years had 102% higher odds of having more than one primary care visit (OR=2.02, 95% CI [1.80,2.27], p=0.000), those aged 56-64 years had 210% higher odds (OR=3.10, 95% CI [2.71,3.56], p=0.000), those aged 65-75 years had 317% higher odds (OR=4.17, 95% CI [3.59,4.86], p=0.000), while those aged 76-85years had 368% higher odds of having more than one primary care visit (OR=4.68, 95% CI [3.94,5.56], p=0.000). This pattern was not seen in the models of the emergency room and inpatient utilization. Older age group was associated with less likelihood of ER visits. In the models of inpatient visits, only adults aged 65 or more had higher odds of inpatient visits, however, these were not as markedly high as seen with the models of primary care visit.

Similar to what was observed in the model of inpatient visits, there was no association between educational status and primary care visits. In the same vein, uninsured adults with chronic conditions had 37% lower odds of more than one primary care visits (OR= 0.63, 95% CI [0.55, 0.73], p= 0.000); this is similar to what was observed in the models of inpatient utilization.

In summary, having a USC who provides office hours in the evenings and weekends was significantly associated with lower odds of having more than one primary care visit but showed no significant association with the number of primary care visits among those with at least one visit.

Table 4.7: Regression models of primary care utilization

	Binary Logistic			Hurdle Poisson [a]
Variables	Odds Ratios			IRR
	Model 1	Model 2	Model 3	Model 4
Extended office hours	0.793***	0.911*	0.912*	1.001
	[0.726,0.865]	[0.833,0.997]	[0.833,0.998]	[0.952,1.052]
Age groups *18-35years*		1	1	1
		[1,1]	[1,1]	[1,1]
36-55years		2.008***	2.020***	1.227***
		[1.791,2.252]	[1.800,2.268]	[1.100,1.370]
56-64years		3.107***	3.104***	1.354***
		[2.710,3.563]	[2.705,3.561]	[1.207,1.519]
65-75years		4.190***	4.173***	1.486***
		[3.603,4.872]	[3.585,4.858]	[1.315,1.679]
76-85years		4.816***	4.678***	1.653***
		[4.065,5.706]	[3.937,5.558]	[1.467,1.862]
Health Insurance *Any Private*		1	1	1
		[1,1]	[1,1]	[1,1]
Only Public [b]		1.164**	1.150**	1.158***
		[1.059,1.279]	[1.046,1.264]	[1.101,1.217]
Uninsured		0.631***	0.632***	1.025
		[0.545,0.730]	[0.546,0.732]	[0.915,1.148]
Perceived health rated poor		1.311***	1.311***	1.392***
		[1.119,1.535]	[1.120,1.534]	[1.273,1.522]
Heart disease		1.027	1.034	1.134***
		[0.950,1.110]	[0.957,1.118]	[1.081,1.190]
COPD		1.404***	1.394***	1.220***
		[1.243,1.585]	[1.234,1.575]	[1.128,1.320]
Asthma		1.103*	1.054	1.126***
		[1.006,1.210]	[0.958,1.159]	[1.061,1.194]
Diabetes		1.713***	1.740***	1.190***
		[1.563,1.877]	[1.587,1.907]	[1.130,1.254]
Education *≥ 1 year of college*		1	1	1
		[1,1]	[1,1]	[1,1]
Completed high school/GED		0.974	0.971	1.014
		[0.898,1.057]	[0.894,1.054]	[0.965,1.066]
Less than high school		0.954	0.962	1.025
		[0.857,1.061]	[0.865,1.071]	[0.960,1.095]
Census Regions *Northeast*		1	1	1
		[1,1]	[1,1]	[1,1]
Midwest		0.957	0.953	1.035
		[0.852,1.074]	[0.850,1.069]	[0.958,1.118]
South		0.994	1.002	1.075*
		[0.876,1.129]	[0.884,1.135]	[1.001,1.156]
West		0.918	0.913	1.153**
		[0.809,1.042]	[0.805,1.035]	[1.054,1.261]
Non-Hispanic Blacks			0.867***	0.947
			[0.799,0.940]	[0.897,1.001]
Female			1.319***	1.099***
			[1.237,1.405]	[1.051,1.150]
Current Smoker			0.968	1.070
			[0.880,1.064]	[0.994,1.152]

Constant	1.296***	0.409***	0.361***	1.675***
	[1.158,1.449]	[0.343,0.487]	[0.302,0.432]	[1.477,1.900]
Pseudo R squared [c]	0.003	0.067	0.070	
Akaike Information Criteria [c] (AIC)	6.33e+08	5.92e+08	5.90e+08	
Bayesian Information Criteria[c] (BIC)	6.33e+08	5.92e+08	5.90e+08	
Sample size	21,501	21,501	21,501	21,501

Note. Confidence intervals in parentheses. All models include year fixed effects and accounted for survey design of the data. a- Second stage of a Hurdle Poisson model which specifies the number of ER visits for observations with non-zero ER visits. IRR is Incidence Rate Ratios. b- Public insurance in the MEPS indicates individuals with Medicaid or Medicare who do not have private supplemental plans (Medigap). c-Pseudo R squared, AIC, & BIC obtained by running models using weights but without accounting for the survey design of the data because the later does not produce Pseudo R squared. However, no value was obtained for the hurdle Poisson model.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Total annual healthcare expenditures. Table 4.8, shown below, presents three linear regression models of total annual expenditures. Two of the models are ordinary least squares (OLS) regression models, one of the untransformed total annual expenditures, the other of the log-transformed expenditures. The third model is a median regression model of the total annual expenditures which estimates the coefficients by minimizing the absolute deviations from the median. The OLS regression model of the log-transformed expenditures has the highest R-squared value suggesting it is the best of the three since it explains up to 20% of the variation in the model while the other two explain 7% of the variation in the model (see the last row of table 4.8).

The results of the OLS regression of the untransformed expenditures and the median regression are presented as coefficients which represent the change in the arithmetic mean or median of the total annual expenditures respectively, with a change in the independent variable. The results of the OLS regression of the log-transformed expenditures are reported as exponentiated coefficients which represent the percent change in the geometric mean of the total annual expenditures with a change in the independent variable.

All three models show reduced expenditures with the provision of extended office hours by the usual source of care after adjusting for covariates. However, the OLS regression model of

the untransformed expenditures was not statistically significant. The model of the log-transformed variable shows a 17% decrease in the geometric mean of total annual expenditures with the provision of extended office hours at the USC (exp (β) = 0.83, 95%CI [0.77, 0.90], p = 0.000), conditioned on covariates. This translates to a reduction of $476.11 in the geometric mean of total annual healthcare expenditures. Similarly, the median regression model shows a reduction of $272.70 ($\beta$= -272.7, 95%CI [-442.1, -103.70, p = 0.002) in the median total annual health expenditures with the provision of extended office hours. This translates to a 7.14% decrease from the median total annual healthcare expenditures of $3822 for adults without a USC offering extended hours.

Other covariates in the regression models of expenditures also show significant associations with total annual expenditures (see table 4.8). Older age group, poor perceived health, a diagnosis of heart disease, COPD, asthma, diabetes, or high blood pressure, and female sex were associated with significant increases in total annual healthcare expenditures. Notably, adults with chronic conditions aged 76-85 years had 563% more expenditures compared to adults aged 18-35years, those aged 65-75 years had 478% more, those aged 56-64 years had 364% more, while those aged 36-55 years had 170% more expenditures compared to those aged 18-35 years (see column 2 of table 4.8).

Study participants who were uninsured had less than a college education or were non-Hispanic Blacks had significantly less total annual health care expenditures compared to the reference groups. Similarly, living in the South or West US census region were associated with significant decreases in total annual healthcare expenditures.

In summary, having a USC who provides office hours was significantly associated with a significant reduction in total annual healthcare expenditures.

Table 4.8: Regression models of total annual healthcare expenditures in 2013 US dollars

	OLS of untransformed expenditure	OLS of log-transformed expenditure	Median regression
Variables	Coefficients	Exponentiated Coefficients	Coefficients
Extended office hours	-533.7	0.833***	-272.7**
	[-1080.4,12.92]	[0.769,0.901]	[-442.4, -103.0]
Age groups *18-35years*	0	1	0
	[0,0]	[1,1]	[0,0]
36-55years	1996.1***	2.699***	1017.0***
	[1138.4,2853.8]	[2.378,3.063]	[787.1,1246.9]
56-64years	4281.2***	4.637***	2043.1***
	[3218.1,5344.2]	[4.016,5.354]	[1859.6,2226.6]
65-75years	4641.8***	5.780***	3132.8***
	[3536.8,5746.8]	[5.038,6.632]	[2888.7,3376.8]
76-85years	6011.1***	6.632***	4118.2***
	[4820.6,7201.6]	[5.744,7.657]	[3528.0,4708.5]
Health Insurance *Any Private*	0	1	0
	[0,0]	[1,1]	[0,0]
Only Public [a]	391.0	1.010	-101.4
	[-451.7,1233.7]	[0.937,1.088]	[-264.0,61.26]
Uninsured	-3380.5***	0.250***	-1244.4***
	[-4212.2, -2548.8]	[0.210,0.297]	[-1389.8, -1099.0]
Perceived health rated poor	10005.2***	2.449***	5075.1***
	[8236.6,11773.8]	[2.133,2.811]	[4095.0,6055.1]
Heart disease	3229.7***	1.486***	1384.7***
	[2395.8,4063.5]	[1.395,1.583]	[1252.9,1516.5]
COPD	3840.1***	1.532***	1871.2***
	[2357.7,5322.4]	[1.389,1.689]	[1577.3,2165.1]
Asthma	1657.4***	1.334***	869.8***
	[722.1,2592.8]	[1.222,1.457]	[714.9,1024.7]
Diabetes	4116.1***	2.134***	2502.6***
	[3310.2,4922.0]	[2.010,2.266]	[2122.4,2882.8]
Education *≥ 1 year of college*	0	1	0
	[0,0]	[1,1]	[0,0]
Completed high school/GED	-682.2*	0.821***	-358.2***
	[-1329.3, -35.08]	[0.766,0.880]	[-550.3, -166.0]
Less than high school	-1080.0*	0.683***	-659.6*
	[-2000.8, -159.2]	[0.620,0.753]	[-1161.8, -157.4]
Non-Hispanic Blacks	199.0	0.714***	-570.8***
	[-536.4,934.3]	[0.650,0.784]	[-651.0,-490.5]
Female	633.2	1.494***	567.3***
	[-8.389,1274.8]	[1.390,1.606]	[412.3,722.4]
Current Smoker	543.6	0.946	-47.83
	[-586.9,1674.1]	[0.851,1.051]	[-495.3,399.6]
Census Regions *Northeast*	0	1	0
	[0,0]	[1,1]	[0,0]
Midwest	-339.2	1.055	54.81
	[-1266.8,588.4]	[0.947,1.174]	[-171.7,281.3]
South	-940.6*	0.884*	-236.3*
	[-1876.2, -5.010]	[0.802,0.975]	[-467.2, -5.366]

West	-426.4	0.846**	-335.7**
	[-1358.7,506.0]	[0.761,0.942]	[-559.6, -111.9]
Constant	2764.7***	583.4***	975.9***
	[1255.8,4273.6]	[487.0,698.9]	[766.9,1184.8]
R squared	0.073	0.202	0.072
Sample size	21,501	21,501	21,501

Notes: Confidence intervals in parentheses. All models include year fixed effects and accounted for survey design of the data. a- Public insurance in the MEPS indicates individuals with Medicaid or Medicare who do not have private supplemental plans (Medigap).
* p < 0.05, ** p < 0.01, *** p < 0.001.

Summary. The objective of question 2a is to determine whether there was a significant association between the provision of office hours in the evenings and weekends at the usual source of care and measures of healthcare utilization and expenditures in the population of adults with a chronic ambulatory care sensitive condition (ACSC). The results of the analyses presented above provide preliminary evidence that provision of extended office hours at the usual source of care is significantly associated with lower odds of having one or more ER visit in a year, lower odds of having more than one primary care visit in a year, reduced number of hospital admissions among those with at least one hospital admission in a year, and a decrease in total annual healthcare expenditures among adults with a chronic ACSC who reported having a usual source of care.

Question 2b: Does the Association between Provision of Extended Office Hours at the Usual Source of Care and Health Care Utilization and Expenditures among US Adults with Chronic ACSCs Differ by Insurance Status?

One of the aims of this dissertation is to examine whether the observed associations between the provision of extended office hours and measures of healthcare utilization and expenditures differ by insurance status. To examine this question, subpopulation analyses by insurance status were conducted.

The results of the sub-population analyses are shown in Table 4.9 below. As indicated in the conceptual model, the provision of extended office hours at the USC is not likely to influence

healthcare utilization and expenditures for the Medicaid population given their unique challenges and experiences. The results of this study confirm the conceptual model. Privately insured adults with chronic ACSCs had 12% (OR= 0.88, 95% CI [0.79, 0.99], p= 0.03) lower odds of having at least 1 ER visit (extensive margin), while the Medicaid population showed no reduction in the odds of having at least 1 ER visit with the provision of extended office hours at the USC (see table 4.8 below). Although the relationship between the provision of extended office hours at the USC and the extensive margin of emergency room utilization in the uninsured population was not statistically significant, it was similar in magnitude to that seen for the privately insured.

A similar pattern was observed for the intensive margin of inpatient utilization. The provision of extended office hours at the USC was associated with a significant reduction in the intensive margin of inpatient utilization for the privately insured but no significant association was observed for the Medicaid population, and the uninsured (see table 4.8 below).

The provision of extended office hours at the USC was associated with a reduction in total annual healthcare expenditures for all subpopulations of health insurance categories examined, including the Medicaid population (see table 4.8 below). This was not what I expected given the findings of the subpopulation analyses for ER and inpatient utilization in the Medicaid population. Given no effect of the provision of extended office hours at the USC on ER and inpatient utilization (which are high cost services) in the Medicaid population, I expected that there will be no reduction in total annual healthcare expenditures too. Perhaps surprisingly, the reduction in total annual healthcare expenditures with the provision of extended office hours at the USC observed for the Medicaid population is higher than that observed for the privately insured. The reason for these findings is unclear. Future analysis will focus on exploring and seeking to better understand these findings.

Table 4.9: Regression Models of healthcare utilization and expenditure measures by health insurance coverage, showing estimates of the effect of the provision of extended office hours at the USC

Healthcare Utilization or Expenditure Measure		Private Insurance	Medicaid	Uninsured
Emergency Room Utilization				
Extensive margin	Point *estimate(OR)*	0.881*	0.931	0.882
	95% CI	[0.787, 0.988]	[0.758, 1.144]	[).647, 1.203]
	P values	0.030	0.496	0.425
Intensive margin	*Point estimate(IRR)*	0.965	0.932	0.880
	95% CI	[0.790, 1.179]	[0.758,1.145]	[0.736, 1.052]
	P values	0.727	0.627	0.159
Inpatient Utilization				
Extensive margin	*Point estimate(OR)*	1.084	0.963	0.787
	95% CI	[0.938,1.252]	[0.743, 1.249]	[0.480, 1.292]
	P values	0.272	0.776	0.342
Intensive margin	*Point estimate (IRR)*	0.715**	0.831	1.013
	95% CI	[0.564, 0.906]	[0.619, 1.117]	[0.838, 1.226]
	P values	0.006	0.220	0.891
Primary care Utilization				
Extensive margin	*Point estimate (OR)*	0.911	0.949	0.777
	95% CI	[0.820, 1.011]	[0.765, 1.177]	[0.591, 1.022]
	P values	0.079	0.632	0.071
Intensive margin	*Point estimate(IRR)*	0.959	1.013	1.000
	95% CI	[0.858, 1.072]	[0.913, 1.124]	[0.799, 1.250]
	P values	0.939	0.807	0.999
Total annual healthcare expenditures				
	Point estimate (exponentiated coefficients)	0.875**	0.750*	0.636*
	95% CI	[0.797, 0.961]	[0.599,0.938]	[0.449, 0.901]
	P values	0.005	0.012	0.011

Question 3: Does Accounting for Unobserved Factors Jointly Affecting Provision of Extended Office Hours at the USC and the Dependent Variables Change the Significance and Direction of the Associations Seen in Question 2 Above?

Table 4.9 below presents a comparison of the effects of extended office hours on healthcare utilization and expenditures for the single regression models and the seemingly unrelated regression (SUR) models which allowed for correlation between the error terms of the equations determining extended office hours and the dependent variables. The point estimates, 95% confidence interval, and p values are presented.

The estimates of the effect of extended office hours obtained from the SUR models show statistical significance and are in the same direction as the coefficients obtained from the single models. This suggests that the observed associations between the provision of extended office hours at the usual source of care and measures of healthcare utilization and expenditures are likely not due to unobserved factors that jointly determine having a provider that offers extended office hours and the utilization of healthcare. That is, the observed association between extended hours and healthcare utilization is likely not due to certain types of patients selecting into practices with extended hours. Although other rigorous analytic techniques such as instrumental variable analysis and fixed effect analysis may be better suited for causal analysis, the results of the analysis from the seemingly unrelated regression model move the literature closer to drawing a causal inference on the effect of the provision of extended office hours and healthcare utilization and expenditures.

As shown in Table 4.9 below, the probit regression (single equation) model of emergency room utilization shows a reduction of 1.4% in the predicted probability of having at least one ER visit while the seemingly unrelated regression model shows a reduction of 24.8% in the predicted probability of having at least one ER visit. Similarly, the provision of extended office hours at the USC was associated with a 2.1% reduction in the predicted probability of having more than one PCP visit in the single equation model and a 37% reduction in the predicted probability of having more than one PCP visit in the SUR model. The single equation model and the SUR models of total annual healthcare expenditures yielded very similar results – 17% and 18% reduction in the mean total annual healthcare expenditures with the provision of extended office hours at the USC.

As stated above, the magnitude of the effects shown by the SUR model of total annual healthcare expenditure was very similar to its single equation counterpart (18% vs. 17%). On the other hand, there is a huge difference in the magnitude of the effects shown by the single equation models and the SUR models of emergency room (1.4% vs. 24.8%) and primary care utilization (2.1% vs. 37%). The reason for the huge difference in the magnitude of the effects shown by the single equation models and the SUR models of emergency room and primary care utilization is unclear. Nevertheless, all models were statistically significant and showed similar direction of effects.

While the reason for these huge difference remains unclear, the statistical significance and the similarity of the direction of effects in the two models provide suggestive evidence of a nearly causal relationship between the provision of extended office hours at the USC and the extensive margins of emergency room and primary care utilization, and total annual healthcare utilization.

Table 4.10: Comparison of estimates of the effect of extended office hours from regular regression models and seemingly unrelated regression (SUR) models

Healthcare Utilization or Expenditure Measure		OLS/ Probit Regression Extended Office Hours Marginal effects	SUR (two-equation) Extended Office Hours Marginal effects
Have at least 1 ER visit	*Point estimate*	-0.014	-0.248
	95% CI	[-0.026, - 0.002]	[-0.372, -0.124]
	P values	0.018	0.000
Have >1 PCP visit	*Point estimate*	-0.021	-0.370
	95% CI	[-0.041, -0.001]	[-0.551, -0.189]
	P values	0.044	0.000
Log-transformed total annual expenditures [a]	*Point estimate*	0.833	0.823
	95% CI	[0.769, 0.901]	[0.727,0.930]
	P values	0.000	0.002

a-Exponentiated coefficient reported, not marginal effects.

Chapter 5

Discussion and Conclusion

A growing body of literature examines primary care innovations, such as patient centered medical homes, and suggests mixed effects on healthcare utilization, costs, and health outcomes. However, little is known about the effects of individual reform components and how the innovations affect the growing population of adults with ACSCs. This dissertation addresses these knowledge gaps finding that extended hours for primary care services shows promise for reducing high cost healthcare services and reducing total healthcare expenditures for adults with ACSCs. However, despite these encouraging results, the data also indicate a decline in the availability of extended hours from 2005-2014.

Summary of Findings

Proportion of US adults with a usual source of care offering extended office hours. In 2014, 3 in 4 US adults (75.35%) had a usual source of care, and 1 in 4 (25.07%) of all US adults had a usual source of care providing office hours in the evenings and weekends. In addition, out of all US adults who had a usual source of care in 2014, 1 in 3 (33.28%) had one who offered extended office hours. The proportion of all US adults with a USC that provides extended office hours was slightly higher in the population of adults with chronic ACSCs compared to those without chronic ACSCs. Out of the population of adults with chronic ACSCs, the proportion of those with extended office hours was 26.41%, for those without a diagnosis of ACSCs, this proportion was 24.94%. Although this difference is small in magnitude, it was statistically significant.

In a national study utilizing data from the Medical Expenditure Panel Survey from 2000-2008, the authors find that 35.8% of US adults who had a USC reported provision of extended

office hours by the USC (Jerant et al., 2012b). This is comparable to but slightly higher than the present study's finding of 33.28%. Another national study which utilized data from the 2010 Health Tracking Household Survey found that 40.2% of those with a usual source of care reported that their USC had extended office hours (O'Malley, 2013). This is a much higher estimate than was found in the present study. However, it is probable that the inclusion of children in the participants of that study accounts for this difference. The literature provides some evidence suggesting that the provision of extended office hours is more common in the pediatric population than in the adult population (O'Malley, 2013; Ray & Mehrotra, 2016).

In the present study, as well as other studies cited above, only 1 in 3 providers offered extended office hours. This contributes to evidence that the US is highly under-performing in this area of primary care delivery when compared to other developed nations. A survey of primary care physicians in 11 developed nations reported that nearly all the Dutch, New Zealand, and United Kingdom primary care physicians had a system in place for their patients to see a provider after-hours while the US primary care physicians had the lowest frequency of making provisions for after-hours care (Schoen et al., 2009a).

My findings on the proportion of adults whose USC provides extended office hours suggest potential for improving primary care delivery in the United States by increasing extended hours access. It is clear, from this study, that having a usual provider does not guarantee access to that provider when the need for care arises after hours. The results of the present study show that three in four US adults have a usual provider, but only one in four may be able to see the provider in the evenings or weekends. A substantial proportion of emergency room visits are for acute problems arising outside of regular hours and many of these acute problems are primary care treatable (Niska, Bhuiya, & Xu, 2010; Pitts et al., 2010). Evidence

from the literature suggests that lack of office hours in the evenings and weekends contributes to emergency room utilization among adults who have a usual source of care (Janke et al., 2015; Rust et al., 2008; Uscher-Pines et al., 2013). Ongoing initiatives seek to improve access to primary care, including through the provision of after-hours access (O'Malley et al., 2012). However, findings from the present study suggest huge opportunities for improvement.

Frequency distribution of extended office hours by population characteristics. In a descriptive analysis, this study also explored the distribution of extended office hours by several population characteristics. Many of these, including age, income, marital status, education, and health insurance, were found to be significantly associated with the frequency distribution of having a USC providing extended office hours.

Compared to elderly adults aged 65 years or more, younger (18-35years), middle aged (36-55years), and nonelderly older adults (56-64years) were more likely to have a provider that offers extended office hours. Elderly adults may have less value for a provider offering evening hours because they are less likely to drive at night. On the other hand, nonelderly adults may have more value for the flexibility of being able to see their provider in the evenings and weekends when they are likely to be off work (O'Malley et al., 2012). Consistent with this explanation, the present study also found that individuals who were employed were more likely to have a provider offering extended office hours.

In addition, the present study shows that high-income, married, college-educated, non-Hispanic Whites, and privately insured adults have higher frequencies of having a USC providing extended office hours. These disparities in potential access to primary care are consistent with the literature on sociodemographic disparities in access to healthcare (DeVoe, Fryer, Phillips, & Green, 2003; Kushel, Gupta, Gee, & Haas, 2005; Roos, Walld, Uhanova, &

Bond, 2005; Shi & Stevens, 2005). These findings contribute to the body of research on healthcare disparities. No previous study has described socio-demographic disparities in having potential access to extended office hours.

Ten-year trends in the provision of extended office hours by the USC. This dissertation also examines the trends in the provision of extended office hours by the USC from 2005 to 2014.

Overall trends. Overall, there was a decline in the percentage of US adults reporting that their USC offered evening and weekend hours. While this decline was small in magnitude, this finding suggests no improvement in the percentage of USC expanding office hours to evenings and weekends from 2005 to 2014. This is quite concerning as my analysis suggests that extended hours might play an important role in improving chronic disease outcomes. Given the ongoing implementation of the PCMH initiative which has one of its component advocating enhanced access to primary care through the provision of extended office hours, one would expect an increase in the proportion of providers offering extended office hours. Although my finding of an overall decline in the provision of extended office hours is not what I expected, it is consistent with a previous study in the pediatric population which also showed a decline in the percentage of USC offering extended office hours (Ray & Mehrotra, 2016).

The lack of an increase in the percentage of providers offering extended office hours may be due to a number of reasons. First, patients may be unaware that their usual provider offers extended office hours. In the present study, approximately 1 in 10 adults who have a USC reported they do not know whether their USC offered evening and weekend hours. Second, the PCMH initiative has come under criticism for wide variations in implementation across practices (Hoff et al., 2012), hence primary care practices may be implementing strategies other than the

provision of extended office hours to enhance access to care. Consistent with this explanation, a previous study examining trends in primary care access in the pediatric population found a decrease in the provision of extended office hours and an increase in other access enhancing strategies such as the ease of contacting the provider by phone during office hours (Ray & Mehrotra, 2016).

It is perhaps not surprising that primary care providers are choosing other PCMH strategies over the provision of extended office hours. While the provision of extended office hours is likely beneficial for the patient and may yield savings for the healthcare system, the extra overhead cost and staffing necessary to keep primary care offices open in the evenings and weekends may be a major impediment to the provision of extended office hours by primary care practices (O'Malley et al., 2012).

In addition, the present study also showed an overall decline in having a USC for all adults, and for subpopulations of adults with and without a chronic ACSC from 2005 to 2014. Although this decline is small in magnitude, it was statistically significant. Given that the US already ranks below other developed nations in its healthcare care delivery system (Schoen et al., 2009a; Davis, Stremikis, Squires, & Schoen, 2014), a decline in having a usual provider is quite concerning and is a signal to further intensify ongoing efforts at improving the US primary care delivery system. However, it is worthy of note, that a detailed examination of the trends from year to year showed a slight increase from 2013 to 2014. This increase coincides with the first open enrollment period of the health insurance market place from October 2013 to March 2014, with health insurance coverage beginning in January 2014. This finding corroborates the growing evidence that the implementation of the affordable care act (ACA) has been associated with higher insurance rates, higher rates of having a usual source of care, and less unmet

healthcare needs (Glied, Ma, & Borja, 2017; Miller & Wherry, 2017; Shartzer, Long, & Anderson, 2015; Sommers, Gunja, Finegold, & Musco, 2015; Sommers, Maylone, Blendone, Orav, & Epstein, 2017). Given the ongoing efforts by the current administration to scale back the ACA, it is questionable whether these gains will be sustained.

Trends in the provision of extended office hours across select population characteristics. The trends in the provision of extended office hours at the USC across subpopulations of adults based on the region of residence, health insurance coverage, and elderly vs. nonelderly adults mirror the overall trends in showing a net decline from 2005 to 2014. However, there are some findings that are worthy of note. First, the Southern region of the US had the lowest percentage of providers offering extended office hours in all ten years of data examined. However, while other regions showed a net decline from 2005 to 2014 in the provision of extended office hours, the Southern US region showed a net increase. This suggests some efforts at improving access to primary care in this region. Second, the Northeastern region, which consistently had the highest percentage of providers offering extended office hours had the largest decline of a statistically significant 5 percentage points reduction in the provision of extended office hours between 2005 and 2014. Third, while elderly adults consistently had a lower percentage of USC offering extended office hours compared to nonelderly adults across all 10 years, there was a net increase in the provision of extended office hours for elderly adults and a net decline for nonelderly adults. All three patterns described above show some improvement in subpopulations with the lowest percentage of the provision of extended office hours and a decline in subpopulations with the largest percentage. Improvement in the provision of extended office hours for populations that were previously lagging behind is encouraging. However, the overall trend is dominated by declines for populations that previously had the highest percentage

of providers offering extended office hours. Usually, efforts at lowering disparities involve focusing more on disadvantaged populations. This finding suggests that efforts at improving the provision of extended office hours should focus on the disadvantaged populations without neglecting populations that were previously doing well.

Association between extended office hours and measures of healthcare utilization and expenditures. The aim of the second and third research questions of this dissertation is to examine the association between extended office hours at the usual source of care and measures of healthcare utilization and expenditures in the population of adults with chronic ACSCs.

This study finds that the provision of extended office hours at the usual source of care is associated with less likelihood of having an ER visit in a year (a reduction in the extensive margin of ER utilization), less likelihood of having more than one primary care visit in a year (a reduction in the extensive margin of primary care utilization), reduced number of hospital admissions among those with at least one hospital admission in a year (a reduction in the intensive margin of inpatient utilization), and a decrease in total annual healthcare expenditures among adults with a chronic ambulatory care sensitive condition. It is possible that the observed associations between extended hours and healthcare utilization and expenditures are due to certain types of patients selecting into practices that offer extended hours. However, these associations remained after using seemingly unrelated regression models to mitigate residual selection bias in the regression models of the relationship between extended office hours and measures of healthcare utilization and expenditures. Although these relationships are not strictly causal, the findings presented in this dissertation draw the literature closer to making a causal inference on the association between the provision of extended office hours and healthcare utilization and expenditures.

Association between extended office hours and ER visits. The finding of the present study showing an association between extended office hours at the usual source of care and reduction in the likelihood of at least one ER visits is consistent with previous studies on this topic (Lowe et al., 2005; O'Malley, 2013; Zickafoose et al., 2013). This finding is not surprising, as one common access-related reason for ER visits is, "the doctor's office is not open when a patient needed care" (Janke et al., 2015; Rust et al., 2008).

As previously discussed in the conceptual model in chapter 2 above, the provision of extended office hours at the usual source of care offers an alternative to ER utilization for non-emergent conditions. Further, the provision of extended office hours at the usual source of care improves continuity and care coordination in primary care delivery (O'Malley et al., 2013). Consequently, it is likely that the provision of extended office hours also reduces emergency room utilization by improving the outcomes of adults with chronic ACSCs, including preventing acute exacerbation of chronic diseases which would have otherwise necessitated emergency room care.

The results of the present study contribute to the existing literature in two ways. First, none of the previous studies examined the effect of extended office hours on ER utilization in the population of adults with chronic ACSCs. This population is unique because they are more likely to be in poorer health and more likely to use the ER (Billings & Raven, 2013). Demonstrating a reduction in ER utilization with the provision of extended office hours at the USC in this vulnerable population with higher rates of ER visits presents an opportunity for lowering national ER utilization rates. Second, by utilizing a more rigorous analytical technique, the results of this study approximate a nearly causal inference on the effect of the provision of extended office hours at the usual source of care on ER visits.

In addition, this study builds on previous literature by examining the effect of extended office hours on the intensive margin of ER utilization. Among those who had at least 1 ER visits in a year, this study found no significant association between extended office hours and the intensity (intensive margin) of ER visits. This suggests that the provision of extended office hours at the usual source of care is effective in preventing occasional ER utilization, but not effective in preventing multiple ER utilization. The reason for this finding is unclear.

A possible explanation is that multiple utilizers of the ER do so for high acuity conditions that are not primary care treatable. Evidence from the literature suggests that frequent ER utilizers are often sicker and generally have higher acuity complaints when they present to the emergency room (Billings & Ravens, 2013; LaCalle & Rabin, 2010). In a more recent study to identify the impact of primary care site level characteristics on multiple ER utilization among enrollees of the Geisinger Health Plan, the authors concluded that patients' health conditions and care needs rather than primary care site characteristics are major drivers of multiple ER utilization (Maeng, Hao, & Bulger, 2017). These findings suggest that lack of access to primary care is probably not a big contributor to multiple ER utilization. Further research is necessary to confirm the lack of association between the provision of extended office hours at the USC and the intensive margin of ER utilization, and to further determine the reason for this lack of association.

Association between extended office hours and ER utilization across insurance categories. Given some evidence in the literature suggesting that some Medicaid patients prefer the emergency room regardless of whether their primary care provider was open (Capp et al., 2015; Kangovi et al., 2013), this study also sought to examine whether there was a difference in the effect of extended office hours on ER visits by insurance categories. A subpopulation

analysis of the effect of extended office hours on healthcare utilization and expenditures across different insurance categories found no significant association between the provision of extended office hours and the likelihood of having at least one ER utilization (extensive margin) in the Medicaid and uninsured population while the provision of extended office hours was associated with 12% less likelihood of having an ER visit in the privately insured population. It is worthy of note, however, that while the association was not statistically significant for the uninsured, the magnitude of the association was identical to that of the privately insured.

This study's finding of no association between extended hours and ER utilization in the Medicaid population is consistent with evidence from qualitative studies indicating that some Medicaid patients prefer to utilize the ER because the ER affords the convenience of getting laboratory studies, imaging studies, and specialty care in one facility (Capp et al., 2015; Kangovi et al., 2013). In addition, there is some evidence indicating that increasingly, primary care providers refer non-emergency Medicaid patients to the ER due to several reasons including increased complexity of their illness, relative ease, and unavailability of needed clinical information after hours (Carrier, Yee, & Holzwart, 2011; Morganti et al., 2013). Other reasons cited for frequent ER utilization among Medicaid patients include: negative subjective experiences with primary care practices such as the perception of being treated without respect, lack of trust in the quality of care received from the PCP, and perception of ER care as being less expensive than ambulatory care (Capp et al., 2015, 2016; Kangovi et al., 2013). In addition, Medicaid enrollees are often sicker and have more complex health needs than the privately insured and thus may need more ER care (Kaiser Commission on Medicaid and the Uninsured, 2013; MACPAC, 2012). Consequently, the lack of association between the provision of extended hours and emergency room utilization for the Medicaid population may be due to a

higher level of illness complexity in this population. Although the regression models also controlled for poor self-rated health, this variable may not fully capture illness complexity. It is evident from the foregoing that to achieve a reduction in ER utilization among the Medicaid population, other strategies aimed at addressing the specific challenges of this population will have to be considered.

In addition, this study examined the association between the provision of extended office hours and the intensive margin of emergency room utilization across health insurance categories. Similar to the findings for the entire population of adults with chronic ACSCs, the results show no relationship between the provision of extended office hours and the intensive margin of emergency room utilization across all insurance categories.

Extended office hours and inpatient utilization. This study finds no association between the provision of extended office hours at the USC and the likelihood of having at least one hospital admission (extensive margin) in a year. However, among those with at least one inpatient visit, the provision of extended office hours was associated with a significant reduction in the intensity (intensive margin) of inpatient visits in the year.

Based on the conceptual model discussed in chapter 2 above, the provision of extended office hours at the USC is expected to reduce inpatient utilization. The findings of this study confirm this expectation for the association between the provision of extended office hours at the USC and the intensive margin of inpatient utilization but do not confirm it for the extensive margin of inpatient utilization.

In conjunction with this study's finding of an association between the provision of extended office hours at the USC and a reduction in the extensive margin of ER utilization, this study's finding of no association between the provision of extended office hours at the USC and

the extensive margin of inpatient utilization suggests that the provision of extended office hours at the USC is only associated with reduction in ER utilization for conditions that are not severe enough to require hospitalization. But, the provision of extended office hours at the USC does not preclude seeking care for conditions severe enough to necessitate hospitalization. More research utilizing specific types of ER visits (non-emergent, primary care treatable, emergent) as the outcome variable is necessary to confirm this explanation.

This study's finding of the provision of extended office hours at the USC having no effect on the extensive margin of inpatient utilization while being associated with a reduction in the intensive margin of inpatient utilization suggests that very sick patients, who have higher likelihood of having multiple hospitalizations, are likely to benefit more from the provision of extended office hours at the USC. Further, this finding points to a role for the provision of extended office hours in preventing hospital readmissions. Current efforts at reducing hospital readmissions focus mainly on improving the quality of hospital care (James, 2013; Krumholz et al., 2017). This study's finding of reduction on the intensive margin of inpatient utilization with the provision of extended office hours suggests the possibility of achieving a portion of hospital readmission reduction goals through expansions in extended hours access to primary care.

Extended office hours and primary care utilization. Based on the conceptual model described in chapter 2 above, I hypothesized that the provision of extended office hours could either 1) lead to an increase in primary care utilization by diverting patients who would have otherwise utilized the ER for nonemergent conditions to the primary care office or 2) lead to a reduction in primary care utilization through improved outcomes and overall reduction in the need for all types of healthcare. This study finds that the provision of extended office hours is associated with a reduced likelihood of having more than one primary care visit in a year,

confirming the second hypothesis.

In addition to the provision of extended office hours at the USC leading to improved outcomes and an overall reduction in the need for all types of healthcare, another potential explanation for this finding is that individuals who have providers offering extended hours are enabled to be more pragmatic in their care seeking decision making. For example, if an individual with a chronic disease develops a new symptom on a Friday, the assurance of being able to see their PCP over the weekend should the symptom worsen may encourage them to adopt "watchful waiting" rather than seek to be seen on Friday because the next day is a weekend. Some symptoms eventually resolve without treatment. Another potential reason for this study's finding of an association between extended hours and a reduction in primary care utilization is that perhaps some of the decreases in primary care utilization is being offset by specialist visits. This will be further explored in future studies.

In the present study, the provision of extended office hours at the USC is associated with a reduction in service utilization across all three types of healthcare visits. Consistent with this finding is the evidence from the literature that primary care utilization and emergency room utilization are complementary rather than substitutionary (Doupe et al., 2012; Hansagi, Olsson, Sjoberg, Tomson, Goransson, 2001; Maeng et al., 2017).

Extended office hours and total annual expenditures. Considering this study's findings of reduction of all types of healthcare utilization with the provision of extended office hours, it is not surprising that the results of this study also shows a reduction in total annual expenditures with the provision of extended office hours at the USC. This is consistent with previous literature (Jerant et al., 2012). Other studies on the effect of extended office hours on healthcare expenditures found reductions in ER expenditures and outpatient expenditures but found no

significant association with total expenditures (Philpot et al., Stockbridge et al., 2014). However, these studies examined a different population.

Summary. Briefly, the findings of this dissertation can be summarized as follows. First, only 1 in 4 US adults has a USC offering evening and weekend hours (extended office hours). Second, there are sociodemographic disparities in the provision of extended office hours at the USC. Third, in the population of all US adults, ten-year trends in the provision of extended office hours at the USC showed a net decline from 2005 to 2014. Fourth, subpopulations (those living in the Northeastern US region and non-elderly adults) who had the highest percentage of having a USC providing extended office hours are showing a net decline from 2005 to 2014 while subpopulations (elderly adults and those living in the Southern US region) who had the lowest percentage are showing a net increase from 2005 to 2014. Fifth, in the population of adults with chronic ambulatory care sensitive conditions, the provision of extended office hours at the USC is associated with a reduction in total annual expenditures and all three types of healthcare utilization examined, including primary care. Sixth, the provision of extended office hours is associated with a reduction in the extensive margin of ER utilization but is not associated with a reduction in multiple ER utilization among those with one or more ER visits. Seventh, the effect of the provision of extended office hours at the USC in reducing ER utilization was not observed among Medicaid patients. Finally, the provision of extended office hours at the USC is not associated with a reduction in the extensive margin of inpatient utilization but associated with a reduction in the intensive margin of inpatient utilization. That is, the provision of extended office hours at the USC was associated with a reduction in multiple hospitalizations or reduction in 360-day readmissions. Given these findings, the next section discusses the implications for policy and practice.

Implications for Policy and Practice

This study provides evidence suggesting that the provision of extended office hours at the usual source of care reduces total annual expenditures and all types of healthcare utilization examined. However, this study also shows a net decline in the provision of extended office hours from 2005 to 2014. These findings are important for the ongoing efforts at reducing the growth in the nation's annual expenditures on healthcare.

The results from this study indicate a savings of $272 and $478 in the median and mean total annual healthcare expenditures respectively with the provision of extended office hours at the usual source of care. However, despite this significant healthcare cost savings associated with the provision of extended office hours at the USC, this study reveals that the percentage of having extended office hours is on the decline. This finding is concerning and unexpected given the current widespread implementation of the Patient Centered Medical Home (PCMH) initiative which has enhanced access to primary care through the provision of extended hours as a component. Considering evidence suggesting a steady increase in the number of primary care practices achieving PCMH certification (Patient-Centered Primary Care Collaborative, 2017), it appears that the PCMH initiative as currently designed and implemented is not associated with an increase in the provision of extended office hours at the usual source of care.

The provision of extended office hours is one of the four "factors" that make up the "Patient-centered appointment access" element of one of six PCMH standards that are scored for PCMH certification. This element must be cumulatively passed at a 50% or higher level to achieve certification as a PCMH ("Patient-Centered Medical Home 2014 Standards", 2016; "National Committee for Quality Assurance (NCQA) Report Cards" 2017). This implies that a primary care practice may achieve recognition as a PCMH by passing two other factors without

providing office hours in the evenings and weekends. It is likely that primary care practices are choosing other factors, such as same day scheduling, which does not require as much additional overhead and staffing cost to implement. Although there is some evidence suggesting that open-access scheduling reduces emergency room utilization (Hudec, MacDougall, & Rankin, 2010), it does not enhance access to primary care when needed outside of regular office hours.

Several challenges to the provision of extended office hours including lack of additional reimbursement for care provided after regular business hours, provider reluctance to take on irregular work schedules, and not having sufficient patients after hours to support the additional investment, have been described in the literature (O'Malley et al., 2012). Given these challenges, it is understandable that providers may be reluctant to provide extended office hours. Nevertheless, given the immense potential for cost savings to the healthcare system associated with the provision of extended office hours, it is imperative for healthcare payers and policymakers to devise ways of incentivizing providers to offer extended office hours.

One way of providing financial incentives for the provision of extended office hours at the USC is to develop policies mandating payers to provide adequate reimbursement for evaluation and management (E & M) billing codes for patients seen after hours. O'Malley and coauthors (2012) reported that providers acknowledge the existence of E & M billing codes for after-hours care but state they never get additional reimbursement for those codes. Without appropriate reimbursement for care provided after hours and other financial incentives, it may be difficult to obtain clinician buy-in.

Another way of incentivizing providers to offer extended office hours is through the Accountable Care Organizations (Margolius and Bodenheimer, 2011). The potential to share savings resulting from the provision of extended office hours is likely to encourage provider

willingness to make necessary structural and administrative changes required to provide extended office hours.

Re-organizing solo and small primary care practices to form larger groups with interoperable electronic health records and centralized after-hours clinic and having the group physicians take turns at staffing the after-hours clinic is another potential way to provide extended office hours for patients. This is likely to reduce physician burn out while ensuring patients have access to after-hours care by providers who can access their medical records. In the Netherlands where virtually all patients have potential access to after-hours primary care, the primary care practices are organized into large "cooperatives" which provide after-hours care for the patient population of all participating physicians (Huibers, Giesen, Wensing, & Grol, 2009; Smits et al., 2017). The provision of care by these cooperatives includes an initial telephone consultation by physician-supervised triage nurses, after which the patient is: referred for in-person consultation with the general practitioner (GP) at the cooperative, seen at home by one of the cooperative's GP, offered self-care advice, or advised to see their GP the next day (Smits et al., 2017; Uden, Giesen, Metsemakers, & Grol, 2006). This model of after-hours primary care has been shown to reduce after-hour workloads and increase physician job satisfaction (Giesen, Smits, Huibers, Grol, & Wensing, 2011).

An important finding of the present study is the lack of association between the provision of extended office hours and healthcare utilization and expenditures in the Medicaid population. This suggests the need to focus intervention efforts on alternate proven measures such as the use of case managers, patient navigators or community health workers to ensure effective primary care utilization in this population (Enard & Ganelin, 2013; Kumar & Klein, 2013; Shunway, Boccellari, O'Brien, & Okin, 2008). Redesigning primary care delivery such that primary care

clinics can provide wrap-around services including imaging services, laboratory studies, and tele-consultation with specialty care, and provide other services that will address the unique needs of the Medicaid population will probably enhance primary care utilization and lead to more efficient use of high acuity care in this population (Capp et al., 2015; MACPAC, 2014).

Finally, this study has implications for the Hospital Readmission Reduction Program (HRRP). This program incentivizes hospitals to make efforts at preventing hospital readmissions by penalizing them financially for excess readmissions (James, 2013). This study finds a significant association between the provision of extended office hours and reduced number of hospital admissions among the population of adults with chronic ACSCs who had at least 1 hospital admission. This finding points to a probable role for the provision of extended office hours in reducing hospital readmissions, thus efforts at reducing hospital readmissions should not be limited to improving the quality of hospital care but should also include expanding access to primary care through the provision of extended office hours at the USC.

Limitations

This study is not without limitations. First, the MEPS data are largely based on self-report data, thus limitations such as recall bias and response bias may exist in this study. However, the MEPS data have been widely used for health services research, and some of the information reported by survey respondents is usually secondarily validated from medical providers and insurance companies.

Second, due to data limitations, I was unable to determine whether patients had access to same-day scheduling and constant phone and email access to the provider. It is possible that some of the observed effects of the provision of extended office hours in reducing healthcare utilization and expenditures are due to other primary care enhancing strategies such as same-day

scheduling, and constant phone and email access to the provider. Since these strategies are encouraged by the patient centered medical home initiative, it is probable that adults who have providers offering extended office hours also have access to same day scheduling or constant phone and email access to the provider. However, in answering the third research question of this dissertation, I jointly estimated the provision of extended office hours and measures of healthcare utilization and expenditures in a seemingly unrelated regression framework, thus mitigating some of the residual bias resulting from this missing information. Yet, I obtained results similar to the analysis for question 2 where I did not utilize the two- equation model.

Third, I was unable to determine whether there was a dose-response relationship between extended office hours and the measures of healthcare utilization and expenditures because there was no information on how many hours outside of the regular business hours the USC remains open. There is some evidence in the literature to suggest that only individuals with 12 hours or more of extended office hours showed a reduction in their ER visits (Lowe et al., 2005). In the present study, the data only provided information on whether the USC offered weekend or evening hours. Nevertheless, this study finds significant associations between the provision of extended office hours and the measures of healthcare utilization and expenditures examined in this study. Given the additional overhead cost and staffing required to run after-hours clinics, it is imperative to determine how much extended hours is necessary to achieve optimal patient outcomes and cost savings.

Fourth, approximately 10% of the study sample reported “do not know” on the availability of extended hours and were dropped from the analysis. This may have resulted in some bias, however sensitivity analyses in which these were included in the regression analysis

as a separate category showed similar estimate on the association between extended hours and healthcare utilization and expenditures.

Finally, this study examined the effect of the provision of extended office hours on all-cause emergency room utilization. That is, it did not differentiate between emergency room utilization for trauma, obstetric conditions, primary care treatable or avoidable conditions, and clearly emergent conditions. Similarly, for inpatient utilization, this study examined all-cause inpatient utilization rather than hospitalization for ambulatory care sensitive conditions. However, restricting our study population to US adults with chronic ambulatory care sensitive conditions may have reduced the effect of this limitation. Nevertheless, future research should examine the effect of the provision of extended office hours at the USC on non-emergent and emergent ER visits, and hospitalizations for ambulatory care sensitive conditions.

Despite these limitations, this study contributes valuable evidence to the existing literature on the provision of extended office hours at the USC.

Future Research Opportunities

Although the third research question of this dissertation makes some attempts at approximating a causal relationship between the provision of extended office hours and healthcare utilization and expenditures, further research is necessary to establish causality. More rigorous analytical methods such as instrumental variable analysis and fixed effects analysis should be explored to confirm the presence of a causal relationship between the provision of extended office hours at the USC and health care utilization and expenditures.

In addition, cost-effectiveness and cost-benefit analyses on this topic will offer more context to policy discussions on the provision of extended office hours at the usual source of care. Such information will be useful to determine whether it is worthwhile to encourage the

provision of extended office hours at the USC and if it is, how much financial incentives will be necessary to encourage clinician willingness to make the structural and administrative changes necessary to offer extended office hours.

Although some of the age variations in access to extended hours in the present study may have captured the effect of employment on the relationship between extended hours and healthcare utilization, the role of employment on the association between extended hours and healthcare utilization and expenditures should be explored in future analysis.

Additionally, as more recent data becomes available, the estimation of the proportion of US adults who have a USC providing extended office hours should be re-examined to track the nation's progress.

Finally, the effect of the provision of extended office hours on emergency room utilization for emergent versus non-emergent conditions should be examined, and more research on the relationship between the provision of extended office hours and the intensive margins of ER utilization are necessary to confirm the findings of this study.

Conclusion

In conclusion, this study showed that only 1 in 4 US adults had a usual source of care providing office hours in the evenings and weekends. This finding was similar for subpopulations of adults with and without chronic ACSCs. It also showed that, for the population of US adults with chronic ACSCs, the provision of extended office hours at the usual source of care was associated with a reduction in the extensive margin of emergency room utilization, the intensive margin of inpatient utilization, the extensive margin of primary care utilization, and total annual healthcare expenditures. This study found no association between the provision of extended office hours at the usual source of care and the intensive margin of emergency room

utilization, the extensive margin of inpatient utilization, and the intensive margin of primary care utilization. Further, this study found no association between the provision of extended office hours at the USC and emergency room utilization (both extensive and intensive margins) in the subpopulation of adult Medicaid patients with chronic ambulatory care sensitive conditions.

The findings of the present study and those of previous studies on this topic are important for national efforts on improving chronic disease outcomes and reducing national healthcare expenditures. The finding of reduction in the extensive margin of emergency room utilization with the provision of extended office hours at the USC suggests that the provision of extended office hours at the USC may be a viable way of reducing utilization of the ER for primary care treatable conditions while maintaining the continuity and care coordination functions of primary care. On the other hand, the provision of extended office hours at the USC was not associated with a reduction in emergency room utilization in Medicaid patients, thus other strategies such as case management, and restructuring primary care practices to provide wrap-around services including laboratory and imaging studies and specialty tele-consults, may be more effective at reducing emergency room utilization in the Medicaid population.

Finally, this study's finding of a reduction in the intensive margin of inpatient utilization with the provision of extended office hours suggests that expanding access to primary care through the provision of extended office hours has the potential for improving outcomes for very sick individuals.

Future studies should focus on determining the cost-effectiveness of the provision of extended office hours and establishing causality between the provision of extended office hours at the USC and measures of healthcare utilization and expenditures.

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